Industrial QUALITY CONTROL

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The Ampex Quality Rating System

An Application of the Bendix Vendor Quality Rating System to a Small Plant

Highlighting the Annual Convention

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From the President's Desk

The Society's Annual Convention

Once a year your Society underwrites a large and important promotion known as the Annual Convention. This year it will be staged in Detroit on May 22, 23, and 24th, at which time our 'finest yet' seems to be indicated.

Our conventions are conscientiously designed to afford the greatest possible service to the largest possible percentage of our membership. In this objective we strive to include:

(a) A technical program of top quality papers on timely topics, new developments, and applications, presented by speakers of the highest caliber.

(b) An exposition featuring the latest in tools, gages, systems, procedures, services, and products as presented by exhibitors sponsoring them.

(c) Social activities of a nature and in such amount as to offer opportunities for exchange of ideas, discussion of problems, and generally becoming apprised of developments in the entire field.

(d) Insurance that each registrant can return home amply rewarded for the time spent and further fortified in his chosen profession, as well as having justified the cost of his sponsor's subsidy.

To meet adequately such an objective, extreme care is required in setting up our conventions. We must select cities with adequate, first-class hotels for housing our guests, ample space for technical sessions to be presented in acceptable atmosphere, ample facilities for staging and viewing the exhibits, facilities to serve high-quality meals to the large group attending, and all this within reasonable accessibility to the greatest number of members. Unfortunately, relatively few cities in the country meet these requirements, and it becomes necessary at times to pass up some important areas with our convention programs. This is sometimes disappointing, but the situation holds promise of relief in terms of our expanding Division and Regional Conferences that can serve these areas.

Conventions since the first Annual Convention have been a source of growth capital for the Society, and as such represent an important aspect of the Society's operation. This implies careful budgeting, planning, and execution by experienced and capable people. Thus far the favorable net balance resulting from our conventions has been invested in the growing Securities Account, which serves, in turn, as a cushion against any possible "rainy day".

A highly important adjunct of the convention, too, is that of developing increased confidence in our Society, its membership, its policies, its activities, and its *value* to industry—the primary sponsor. This requires a program, technical and social, of the highest possible character, a program compatible with the high ideals of a professional society.

It should be obvious that building and executing a convention to achieve all this requires the cooperation of many people. Moreover, since the entire results reflect upon the Society as an entity, this job must be completely under the jurisdiction of the management group of the Society. Individuals of mature judgment and with a sound background in the history, aims, ideals, objectives, and problems of the Society must be looked to for guidance. Competent persons must be charged with responsibility to the management group and provided with proper support and latitude to execute the plan.

Voluntary efforts of a small group guided by Wade Weaver, Past President and General Chairman of our convention activities, have been one of the most valuable assets in the growth of the Society during the past six years. Their planning, foresight, and excellent execution of these conventions asks as a single reward your attendance at the show which is designed primarily with you in mind.

This year Herman Bogin is the host city chairman for our convention in Detroit. The 'best yet' is the promise coming from the Motor City. You owe it to yourself and the organization you represent to be a part of the convention on May 22, 23, and 24th. And beyond that—keep in mind with the rest of us Boston in 1958, Cleveland in 1959, and San Francisco in 1960.

See you in Detroit.

Dale L. Lobsinger

The Simplex Method for Solving Linear Programming Problems

CARL E. NOBLE

Kimberly-Clark Corporation, Neenah, Wis.

Introduction

Linear Programming is a method for optimizing a linear function $f(x_1,x_2, \ldots x_n)$ when the variables $x_1,x_2, \ldots x_n$ are subject to a set of linear constraints. There is a wide range of problems solvable by linear programming methods, particularly in the area of scheduling production and shipments. Even though the basic theory for solving these problems has been known for many years, it has been only during the past ten years that practical methods have been developed. The "Simplex Method" [1,3] is the most general of these methods and should become familiar to the beginner in linear programming.

This article shows how the simplex method is applied in solving two industrial problems. Only addition, subtraction, multiplication, and division are involved in obtaining a solution to these problems after they have been formulated in mathematical terms. However, we do not wish to imply that linear programming is characterized by nothing more complicated than these computational operations. Two major difficulties in solving linear programming problems are:

1. *Formulating the problem.* Often it will be necessary to consult with a mathematically trained individual to help in setting up the problem.[2]
2. *Performing the routine but detailed arithmetic computations* required to carry through even the common problems that involve three or more variables. This difficulty has been partially overcome with the aid of high-speed computing equipment and through the development of both exact and approximate methods requiring less computation. Some of these short cut methods will be mentioned later.

Scheduling Production for Maximum Profit

In the first problem of this article, we are producing two grades, X and Y, of paper on a paper machine. Due to raw materials restrictions not more than 400 tons of grade X, and 300 tons of grade Y, can be produced in a week. Let the numbers of tons of grades X and Y produced during the week be denoted by x and y respectively. Then,

$x \leq 400$ and $y \leq 300$.

It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively. Since there are available 160 production hours each week,

$0.2x + 0.4y \leq 160$, or $x + 2y \leq 800$.

The profit Z for the week is given by the function

$Z = 20x + 50y$,

showing the profit to be \$20 per ton of X and \$50 per ton of Y. The problem is to determine the values of x and y which maximize the profit function

$Z = 20x + 50y$,

subject to the restrictions

$$\begin{aligned} x &\leq 400 \\ y &\leq 300 \\ 2y + x &\leq 800 \end{aligned} \qquad (1)$$

This is essentially the problem described graphically in Ref. (4). Waugh and Burrows also utilize the graphical approach in solving linear programming problems in Ref. (9).

Since $x \geq 0$ and $y \geq 0$, the values of x and y must fall on the boundary or within the polygon enclosed by the lines $x = 0$, $y = 0$, $x = 400$, $y = 300$, and $x + 2y = 800$. The optimal solution occurs at a corner because Z is a maximum when the family of parallel lines $Z = 20x + 50y$ are as far as possible from the origin.

Figure 1 shows the corner to be $x = 200$, $y = 300$, or (200,300). Hence, the maximum profit is

$Z = \$20(200) + \$50(300)$ or \$19,000.

If the line $Z = 20x + 50y$ had been parallel to one of the sides of the polygon, say $x + 2y = 800$, then the optimal values of x and y could fall any place on the line $x + 2y = 800$ between the vertices (200, 300) and (400, 200).

Simplex Method Applied to Problem I

The graphical method of solution works well for two independent variables x and y, but another method of solution must be called upon in the typical industrial problem involving from four up to 20 or more independent variables. Dantzig [1,3] developed an algebraic method, called the "Simplex Method" for solving such problems, and we shall illustrate its use in this example.

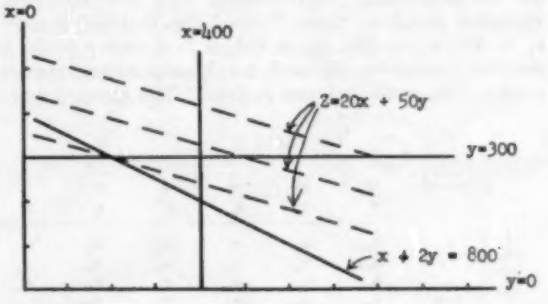

Figure 1

TABLE I

c →		20	50	0	0	0	0
↓		x	y	s_1	s_2	s_3	r
0	s_1	1		1			400
0	s_2		1		1		300
	s_3	1	2			1	800
0	z	0	0	0	0	0	0
	z−c	−20	−50	0	0	0	0

First, the inequalities are made into equalities by introducing non-negative and zero valued variables called *slack variables*. The slack variables are denoted by the symbols s_1, s_2, and s_3 and the Inequalities (1) become Equations (2):

$$\begin{aligned} x + s_1 &= 400 \\ y + s_2 &= 300 \\ x + 2y + s_3 &= 800 \end{aligned} \qquad (2)$$

or

$$\begin{aligned} 1 \times x + 0 \times y + 1 \times s_1 + 0 \times s_2 + 0 \times s_3 &= 400 \\ 0 \times x + 1 \times y + 0 \times s_1 + 1 \times s_2 + 0 \times s_3 &= 300 \\ 1 \times x + 2 \times y + 0 \times s_1 + 0 \times s_2 + 1 \times s_3 &= 800 \end{aligned}$$

The variables x, y, s_1, s_2, and s_3, and the computational symbols are removed from these equations and the remaining numbers placed in rows and columns in a systematic manner as shown in Table I. This array of numbers may be referred to as a *matrix*. The numbers are bordered on the left with the slack variables and across the top with the appropriate variables.

The entire configuration (shown in Table I) is then bordered at the top and left by the c's which are the profits per ton of X, Y, s_1, s_2, s_3, and r, and are equal respectively to 20, 50, 0, 0, 0, and 0.

The z's are the sums of the products of each element in the particular column and the c on the left in the same row as this element. For example, in Table I, z_x in the x column is equal to $1 \times 0 + 0 \times 0 + 1 \times 0$ or 0. The value $z_x - c_x$ equals $0 - 20$ or -20, where the c_x of 20 is obtained from the top row in the x column. The terms in the z − c row are called *indicators*, while the terms in the r column are called *requirements*. The equations and the matrix must be expressed in such a form that the requirements are *positive*.

The slack variables s_1, s_2, and s_3 were introduced to give a unit matrix which forms the basis for beginning the solution of the problem. Each basis variable must have *a positive coefficient of 1 and appear in only one of the equations*. A solution to the problem by the simplex method is found by letting basis variable equal the corresponding requirements and the non-basis variables equal 0. From Table I the first solution is: $s_1 = 400$, $s_2 = 300$, $s_3 = 800$, $x = 0$ and $y = 0$. It satisfies Equations (2) and graphically represents the vertex (0,0) of the polygon in Fig. 1. The z_r in column r

TABLE II

c →		20	50	0	0	0	
↓		x	y	s_1	s_2	s_3	r
0	s_1	a_{1x}	a_{1y}	a_{11}	a_{12}	a_{13}	a_{1r}
0	s_2	a_{2x}	a_{2y}	a_{21}	a_{22}	a_{23}	a_{2r}
0	s_3	a_{3x}	a_{3y}	a_{31}	a_{32}	a_{33}	a_{3r}
	z−c	a_{1x}	a_{1y}	a_{11}	a_{12}	a_{13}	

denotes the profit associated with this solution. A solution gives a maximum profit only when all of the indicators are zero or positive. Our first solution is not a maximum because

$$z_x - c_x = -20 \text{ and } z_y - c_y = -50.$$

The smaller of the two negative indicators, that is $z_y - c_y$, designates that the y variable should be introduced into the basis to replace one of the s's. To facilitate the explanation, the numbers in Table I are replaced with the letters a_{jk} as shown in Table II with the z row deleted. The indicators in the z − c row are represented by a_{1x}, etc.

To determine the s_i to be replaced by y in the basis, divide each *positive* quantity a_{1y}, a_{2y} and a_{3y} into the corresponding a_{1r}, a_{2r}, and a_{3r} to obtain φ_{1y}, φ_{2y} and φ_{3y}. In our example, only a_{2y} and a_{3y} are positive numbers. Hence,

$$\varphi_{2y} = a_{2r}/a_{2y} = 300/1 = 300$$
$$\varphi_{3y} = a_{3r}/a_{3y} = 800/2 = 400$$

Since φ_{2y} is the smaller, y should replace s_2, the basis variable in the same row as a_{2y} and a_{2r}. The term a_{2y} is called the *pivot*.

The next step is to generate from the matrix in Table I a second matrix having s_1, y, and s_3 in the new basis. The new matrix is shown in Table III. In the new transformed matrix the elements in the y row are found by dividing each element in the s_2 row of Table I and II by the *pivot* which is a_{2y} (or 1 in Table I). When this division is carried out, a'_{2y} the transform of the pivot must be 1, of course, regardless of the value of the pivot. All other elements in the new y column are 0. To find the transforms of those elements not in the pivot row or pivot column, consider the following diagram representing elements in Table I or II:

We wish to find transform E' of element E. P denotes the pivot, C the element in the same column as P and the same row as E, and R the element in the same row as P and the same column as E. We find the product of R and C and divide it by P. The quotient is subtracted from E to give E'. That is, $E' = E - \dfrac{R \times C}{P}$.

Thus, the a'_{1x} in Table III is given by the formula,

$$a'_{1x} = a_{1x} - \frac{(a_{2x})\ (a_{1y})}{a_{2y}}$$
$$= 1 - \frac{(0)\ (0)}{1} = 1.$$

The other elements of Table III are found in a similar manner.

For example,

$$a'_{3r} = a_{3r} - \frac{(a_{2r})\ (a_{3y})}{a_{2y}}$$
$$= 800 - \frac{(300)\ (2)}{1}$$
$$= 200$$

Table III shows that Equations (2) have been transformed into a new set of equations:

$$1 \times x + 0 \times y + 1 \times s_1 + 0 \times s_2 + 0 \times s_3 = 400$$
$$0 \times x + 1 \times y + 0 \times s_1 + 1 \times s_2 + 0 \times s_3 = 300$$
$$1 \times x + 0 \times y + 0 \times s_1 - 2 \times s_2 + 1 \times s_3 = 200$$

or

$$\begin{aligned} x + s_1 &= 400 \\ y + s_2 &= 300 \\ x - 2s_2 + s_3 &= 200 \end{aligned} \qquad (3)$$

Equations (3) may be calculated directly from Equations (2) by replacing y in the third equation of (2) with its equal in the second equation. The first two equations remain unchanged. Even if this method is used, some system involving indicators is necessary to show the step to take next and when an optimum solution is reached.

TABLE III

c →		20	50	0	0	0	0
		x	y	s_1	s_2	s_3	r
0	s_1	1		1			400
50	y		1		1		300
0	s_3	1			−2	1	200
	z−c	−20	0	0	50	0	15000

The new matrix in Table III has moved the solution from vertex (0, 0) to (0, 300). We see from the indicator in the r column that the profit has increased from 0 to $15,000. However, the x indicator of −20 implies that a maximum profit has not been reached. Repeating the steps above, we find that x must replace s_3 in the basis and a new matrix shown in Table IV is obtained. The equations represented in Table IV may be calculated readily from Equations (3).

We observe that all the indicators in Table IV are zero or positive, insuring that the solution, $x = 200$, $y = 300$ produces the maximum profit, $19,000. The slack variable s_1 equaling 200 shows that x is 200 short of its limitation in the inequality $x \leq 400$. The indicator 10 in the s_2 column implies that each unit increase in s_2 (this is equivalent to a unit reduction in the a_{2r}), reduces the profit by $10. For example, if s_2 is increased 100 which insists that $y \leq 200$ instead of $y \leq 300$, then the new maximum profit solution is (400,200) and the profit Z becomes $20(400) + $50(200) or $18,000, a reduction of 100 ($10) from the previous maximum profit of $19,000. Similarly, the indicator 20 implies that if we increase s_3 by 100 and force $x + 2y \leq 700$, then the new maximum profit solution is (100,300) and the profit is reduced by 100 ($20) or $2,000 from the previous figure of $19,000. These indicators represent the rate of change in the profit for changes in s_2 and s_3 as long as x, y, and s_1 remain in the basis for the maximum profit.

Simplex Method to Find a Minimum Solution

The Simplex Method was applied to maximize a profit function in the above example. In our second problem we shall now show how the method is used to minimize a function of a series of variables subject to certain constraints. A cattle feeder wishes to purchase four special feeds F_1, F_2, F_3, and F_4 in order to supply the proper vitamin content to his feed mix. Table V

TABLE IV

c →		20	50	0	0	0	0
		x	y	s_1	s_2	s_3	r
0	s_1			1	2	−1	200
50	x		1		1		300
20	z−c	1			−2	1	200
	y	0	0	0	10	20	19000

gives units of vitamin content in a pound of each type of feed and the cost per pound of the feed.

The feed mix must contain at least 12 units of A, 14 units of B, and 8 units of vitamin C. If x_1, x_2, x_3, and x_4 denote the numbers of pounds respectively of F_1, F_2, F_3, and F_4, then

$$\begin{aligned} 4x_1 + 6x_2 + x_3 + 2x_4 &\geq 12 \\ x_1 + x_2 + 7x_3 + 5x_4 &\geq 14 \\ 2x_2 + x_3 + 3x_4 &\geq 8 \end{aligned} \qquad (4)$$

The total cost Z (in cents) of these feeds is

$$Z = 2x_1 + 5x_2 + 6x_3 + 8x_4$$

The problem is to minimize Z subject to the restrictions given in the Inequalities (4). Non-negative, zero-valued slack variables s_1, s_2, and s_3 are introduced into Equations (4) to obtain the set

$$\begin{aligned} 4x_1 + 6x_2 + x_3 + 2x_4 - s_1 &= 12 \\ x_1 + x_2 + 7x_3 + 5x_4 - s_2 &= 14 \\ 2x_2 + x_3 + 3x_4 - s_3 &= 8 \end{aligned} \qquad (5)$$

No one of the variables in Equations (5) satisfies the necessary conditions to be in the basis, i.e., having a coefficient of +1 and appearing in only one equation. Remember the requirements, 12, 14, and 8 must remain positive. It is possible through algebraic manipulation to modify the equations so that some of the variables may serve in the basis, and this would be wise in many cases. However, we shall merely add a new set of non-negative variables t_1, t_2, and t_3 to the respective equations in (5) to form the basis for applying the simplex method. We obtain:

$$\begin{aligned} 4x_1 + 6x_2 + x_3 + 2x_4 - s_1 + t_1 &= 12 \\ x_1 + x_2 + 7x_3 + 5x_4 - s_2 + t_2 &= 14 \\ 2x_2 + x_3 + 3x_4 - s_3 + t_3 &= 8 \end{aligned} \qquad (6)$$

These t's are artificial variables and must be zero in the final solution. In order to insure that they will be removed from the basis and made zero in the optimal solution, they are made infinitely expensive and given values M.

The matrix configuration for this problem is similar to the one in Table I and is shown in Table VI.

Since we wish to find values of x_1, x_2, x_3, and x_4 which minimize rather than maximize the cost function

TABLE V

	A	B	C	Cost/lb.
F_1	4	1	0	2 cents
F_2	6	1	2	5 cents
F_3	1	7	1	6 cents
F_4	2	5	3	8 cents

Z, the optimal solution is found only when all of the indicators are zero or negative. The largest positive indicator, 10M − 8 in Table VI implies that x_4 should replace one of the t's in the basis. To determine the t to be replaced from the basis and to find all of the elements in the new matrix, we proceed in exactly the same manner as in the previous problem when we maximized Z. Table VII gives the three matrices which are derived as we move to the optimal solution. For the optimal solution,

$x_1 = 0$

$x_2 = 106/77 = 1.3766$

$x_3 = 8/11 = 0.7275$

$x_4 = 116/77 = 1.5065$, and

$Z = 23$ and $23/77$ cents

The indicators in Table VI for the optimal solution have the same meaning as in Table IV. For example, if s_1 is increased by 1 unit and, thus, the number of A vitamins required reduced from 12 to 11, then the minimum cost Z is reduced by 18/77 cents from the previous minimum cost of 23 and 23/77 cents. These rates of change in the minimum Z with changes in the s's would continue as long as x_2, x_3, and x_4 remain in the basis of the optimal solution.

TABLE VI

c →		2 x_1	5 x_2	6 x_3	8 x_4	0 s_1	0 s_2	0 s_3	M t_1	M t_2	M t_3	0 r
M	t_1	4	6	1	2	−1			1			12
M	t_2	1	1	7	5		−1			1		14
M	t_3		2	1	3			−1			1	8
	z−c	5M−2	9M−5	9M−6	10M−8	−M	−M	−M				34M

Summary and Conclusion

The simplex method leads to an optimum solution in all types of problems like the two described above regardless of the number of variables $x_1, x_2, \ldots x_n$. Occasionally, there exists more than one optimum solution. For example, if the indicators for one of the non-basis variables in Table IV had been zero, then this variable could have been introduced into the basis without affecting the profit Z. A second optimum solution would result. Alternate optimum solutions are rather common in certain types of problems, for example, the problem of determining optimum fill on a paper machine. The most convenient solution is selected in these cases.

When the number of variables is large, laborious arithmetic computations can make the simplex method impractical. High speed computers offer relief. Even more promising has been the development of other methods involving less arithmetic computation. W. R. Vogel [8] discusses a number of these methods, namely, the Distribution Method, Modified Distribution Method, Hungarian Method, Relaxation Techniques, and the Vogel Approximate Method. The writer is particularly impressed with a method described by A. E. Paull[7] for minimizing trim waste when manufacturing newsprint. This method is as general as the simplex method and reduces the computation for a large class of problems. There are many short cut methods being used in industry today. We can expect these and others to appear in the literature in the near future.

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TABLE VII

c →		2 x_1	5 x_2	6 x_3	8 x_4	0 s_1	0 s_2	0 s_3	M t_1	M t_2	M t_3	0 r
M	t_1	4	$\frac{14}{3}$	$\frac{1}{3}$		−1		$\frac{2}{3}$	1		$\frac{-2}{3}$	$\frac{20}{3}$
M	t_2	1	$\frac{-7}{3}$	$\frac{16}{3}$			−1	$\frac{5}{3}$		1	$\frac{-5}{3}$	$\frac{2}{3}$
8	x_4		$\frac{2}{3}$	$\frac{1}{3}$	1			$\frac{-1}{3}$			$\frac{1}{3}$	$\frac{8}{3}$
	z−c	5M−2	$\frac{7M}{3}+\frac{1}{3}$	$\frac{17M}{3}-\frac{10}{3}$		−M	−M	$\frac{7M}{3}+\frac{8}{3}$			$\frac{-10M}{8}+\frac{8}{3}$	$\frac{22M}{3}+\frac{64}{3}$
M	t_1	$\frac{63}{16}$	$\frac{77}{16}$			−1	$\frac{1}{16}$	$\frac{9}{16}$	1	$\frac{-1}{16}$	$\frac{-9}{16}$	$\frac{53}{8}$
6	x_3	$\frac{3}{16}$	$\frac{-7}{16}$	1			$\frac{-3}{16}$	$\frac{5}{16}$		$\frac{3}{16}$	$\frac{-5}{16}$	$\frac{1}{8}$
8	x_4	$\frac{-1}{16}$	$\frac{13}{16}$		1		$\frac{1}{16}$	$\frac{-7}{16}$		$\frac{-1}{16}$	$\frac{7}{16}$	$\frac{21}{8}$
	z−c	$\frac{63M}{16}-\frac{11}{8}$	$\frac{77M}{16}-\frac{9}{8}$			−M	$\frac{1M}{16}-\frac{5}{8}$	$\frac{9M}{16}-\frac{13}{8}$		$\frac{-17M}{16}+\frac{5}{8}$	$\frac{-25M}{16}+\frac{13}{8}$	$\frac{53M}{8}+\frac{87}{4}$
5	x_2	$\frac{9}{11}$	1			$\frac{-16}{77}$	$\frac{1}{77}$	$\frac{9}{77}$	$\frac{16}{77}$	$\frac{-1}{77}$	$\frac{-9}{77}$	$\frac{106}{77}$
6	x_3	$\frac{6}{11}$		1		$\frac{-1}{11}$	$\frac{-2}{11}$	$\frac{4}{11}$	$\frac{1}{11}$	$\frac{2}{11}$	$\frac{-4}{11}$	$\frac{8}{11}$
8	x_4	$\frac{-8}{11}$			1	$\frac{13}{77}$	$\frac{4}{77}$	$\frac{-41}{77}$	$\frac{-13}{77}$	$\frac{-4}{77}$	$\frac{41}{77}$	$\frac{116}{77}$
	z−c	$\frac{-5}{11}$				$\frac{-18}{77}$	$\frac{-47}{77}$	$\frac{-115}{77}$	$-M+\frac{18}{77}$	$-M+\frac{44}{77}$	$-M+\frac{115}{77}$	$\frac{1794}{77}$

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The Ampex Quality Rating System

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Introduction

Recently initiated within the Ampex Corporation is a new system for evaluating the quality levels of products at their various stages of fabrication. This article presents in three sections the background resulting in the development of the system, a description of the system itself, and the mathematical and statistical theory relating to the functioning of the system.

The Need for a Quality Rating System

Perfection in manufacturing, while perhaps a very desirable condition, is nevertheless an impossible status to achieve and maintain over an indefinite period of time. No matter how well designed the tool, how skilled the operator, or how efficient the method, the fact remains that the combination of contributing elements will sooner or later create conditions which will result in varying proportions of defective product, the proportions being dependent upon the net effect of the combinations.

In most cases, economics dictate that the proportion or percentage of defective product be kept at a minimum. There are cases where this is not true, but these are the exception rather than the rule. As a consequence, management generally prefers minimum defective product throughout its operations, with the exceptions being analyzed on an individual basis.

One approach to proper evaluation of variation in quality is to establish acceptable norms and to measure any departures from these norms. Remedial action can then be taken whenever the departures become significantly great in the direction of higher operating costs, providing the remedial action itself does not overshadow the anticipated savings.

Complex products such as the magnetic tape recording systems manufactured by Ampex obviously offer high probabilities for deficiencies to exist. The multiplicity of component parts, subassemblies and assemblies, plus the intricacies involved in related phases, such as design and maintenance of functional specifications, present many possibilities for errors.

The primary purpose of a quality rating system is to provide a means for comparing actual quality levels in an equitable fashion with the norms that have been established. Continued deviations from these norms become significant, and management is afforded the opportunity, by means of the rating system, to make intelligent decisions regarding desired action to be taken.

There are many ways in which actual quality levels can be compared with norms; however, selection of a system which presents the comparisons in a simple and realistic fashion is of primary importance.

The System Itself

One method of quality analysis which is commonly used in industry is that of comparing product rejection rates with some fixed allowable standard. As an Ampex example, consider the following data which might be obtained at the quality control inspection station where all Model 600 Mechanical Top Plate assemblies are 100 percent inspected:

Number Top Plates Inspected	Number Rejected	Percent Rejected
60	15	25.0

The above information shows that 25 percent of the top plates inspected were rejected, but does not indicate the percentage of defective characteristics that were found. Furthermore, we cannot determine from this information whether each top plate assembly has few or many characteristics which might possibly be defective. Logically, the more complex an assembly, the greater the number of possible defects.

Therefore, it appears quite unfair and unrealistic to place a unit which has five possible chances for error on the same basis of comparison as one containing five hundred, or even fifty. Obviously this is what we are accomplishing when we look only at the percentage of units rejected, rather than evaluate their quality from the standpoint of number of defects per unit.

Referring again to the top plate example, we find that by analyzing the data in a different light, we obtain an entirely new concept:

Number Top Plates Inspected	Total Characteristics Inspected	Total Characteristics Defective	Percent Characteristics Defective
60	3960	18	0.455

Now we see that even though 25 percent of the top plates were rejected, less than ½ percent of the total characteristics were actually defective. The reason for the significant change in percentage is that each top plate has associated with it 66 possible errors, and therefore the probability of a unit being rejected becomes quite high.

For purposes of analogy, let us examine another situation, this time in conjunction with some arbitrary unit "XYZ", which is of relatively simple design.

Number "XYZ" Units Inspected	Number "XYZ" Units Rejected	Percent "XYZ" Units Rejected
8	2	25.0

Again it is seen that 25 percent of the units checked were rejected. However, in this case let us assume that unit "XYZ", being relatively simple, has associated with it only five possible defects. Performing the same type of analysis as before:

Number "XYZ" Units Inspected	Total Characteristics Inspected	Total Characteristics Defective	Percent Characteristics Defective
8	40	3	7.5

Both the Model 600 Top Plate and unit "XYZ" showed a rejection rate of 25 percent, but less than ½ percent of the top plate characteristics were defective as contrasted to 7½ percent for unit "XYZ". From this it is apparent that it is more realistic to evaluate quality on the basis of defects per unit rather than by unit rejection rates, especially since the more complex units would contain higher probability of unit rejection.

By taking into account the total possible number of defects per unit, and establishing a fixed percentage of this total as an allowable norm, we can measure the quality performance of any particular type of unit by the extent of either its positive or negative deviation from the norm.

The Ampex Quality Rating System in essence operates on this principle. For purposes of simplicity, deviations from the respective norms are translated into numerical ratings with 75.0 being equal to the norm in all cases. This value was selected arbitrarily, based upon the fact that most people regard 75 as being "average" or "normal". Examinations are generally graded in this fashion, and since this is a quality "examination", the same psychology may be applied. Based upon this method, product better than the norm will result in ratings greater than 75.0, while product worse than the norm will have ratings less than 75.0.

As product improves in quality, the rating system is so designed that it yields a rating between 75.0 and 100.0; whereas, if product becomes inferior in quality, the rating system will yield a rating between 50.0 and 75.0. Therefore, a product's rating will always be somewhere between 50.0 and 100.0, being exactly 75.0 if its quality level exactly equals the norm established.

The sequence of procedures used in computing a specific quality rating can be described as follows:

1. Determine the total possible number of defects associated with the unit at the point of inspection or test. Do not include any characteristics of any components, subassemblies, or assemblies which have theoretically been previously inspected and approved. It is permissible to approximate or estimate the total number of possible defects for those units containing a significantly large quantity. (Note that unless reasonable care is exercised in making this choice, the rating may have little meaning. For example, if one personnel group doubles the estimated number of possible defects for its complex assembly in comparison with another group producing as complex a product, the expected rating for the first group's product is better than the latter.)

2. Establish a desired norm based upon ½ percent, 1 percent, etc., of the total possible number of defects per unit.

3. Summarize the inspection data and compare the actual number of defects per unit with the established norm.

4. Compute the quality rating of the unit by translating the deviation from the norm into its proper numerical rating.

5. If so desired, combine ratings for a particular unit over a period of time into an average rating. Another alternative is to combine ratings for several types of units into a common rating for the productive area or department.

The following describes the mathematical and statistical computations necessary to complete Steps 4 and 5.

Technical Development of the System

The technical features of the system involve straightforward mathematical and statistical approaches. By referring to the procedure sequence described above, we can easily analyze the development:

1. The first step is to determine the total possible number of defects associated with the unit at the point of inspection or test. Let P = Total Number of Possible Defects per Unit.

2. Establish a desired norm based upon some fixed percentage of the total possible number of defects per unit. Let p = Fixed Percentage Norm. Therefore, the allowable number of defects per unit insofar as the norm is concerned will be (P)(p).

3. Let N = Total Number of Units Inspected. Also, let D = Total Number of Defects actually found during inspection. Then $\frac{D}{N}$ = Actual Number of Defects

per Unit. A comparison between the actual quality level and the norm can be made by the subtraction $\frac{D}{N} - (P)(p)$. This difference will be positive (+) if the actual quality level is inferior to the norm, and negative (−) if the actual level is better than the norm.

4. The translation into a numerical rating can be more simply accomplished by comparing the actual number of defects D with the corresponding norm. The corresponding norm in this case is (N)(P)(p), since N is the total number of units inspected and (P)(p) is the allowable number of defects per unit. Therefore let us consider the subtraction $D - (N)(P)(p)$ rather than $\frac{D}{N} - (P)(p)$. Again, the difference will be positive (+) if the actual quality level is inferior to the norm, and negative (−) if better than the norm.

5. Every frequency distribution has associated with it an average and a standard deviation. The average is merely the average value of the distribution, while the standard deviation is a measure of the variation, or spread, of the distribution about the average. The standard deviation is usually denoted by the Greek letter sigma (σ) with an appropriate subscript related to the variable being measured.

For our purpose the norm, (N)(P)(p), is assumed to be the average of the distribution, and σ_D is considered the measure of variation about (N)(P)(p). In other words, we have established the average, or norm, and expect the actual number of defects D to vary about the norm.

Statistical theory states that the frequency distribution of D about the norm (N)(P)(p) follows the pattern of the binomial expansion more accurately than any other standard type distribution. Using the binomial assumption, the standard deviation, or σ_D, in this particular case becomes $\sqrt{(N)(P)(p)(1-p)}$.

However, when (N)(P) is large and p is relatively small, only a small error results by replacing the binomial with the Poisson distribution, which always has its standard deviation equal to the square root of the average, or in this case the square root of (N)(P)(p).

Moreover, as (N)(P) increases indefinitely, a fairly accurate estimation of the binomial can be made by use of the normal distribution. This distribution is always symmetrical, whereas the binomial is symmetrical only when $p = 0.5$. Therefore, the normal curve furnishes a better approximation to the binomial when p is close to 0.5 than when p is near 0 or 1, but with (N)(P) large enough, its approximation to the binomial is sufficient for most practical purposes.

With this in mind, let us explore the normal curve application further. It is seen from Fig. 1 that three times the standard deviation, or $3\sigma_D$, when added to or subtracted from the average (N)(P)(p), establishes practical limits for the distribution of D. By making the assumption that the normal and Poisson distributions are approximately the same, it can be further assumed that $\sigma_D = \sqrt{(N)(P)(p)}$ and $3\sigma_D = 3\sqrt{(N)(P)(p)}$. Thus the distribution of D will have as its practical limits $(N)(P)(p) \pm 3\sqrt{(N)(P)(p)}$.

Since we have seen that practically all, or 100 percent, of the distribution is established by $\pm 3\sqrt{(N)(P)(p)}$, it becomes apparent that we can also establish any portion of the distribution by selecting the appropriate

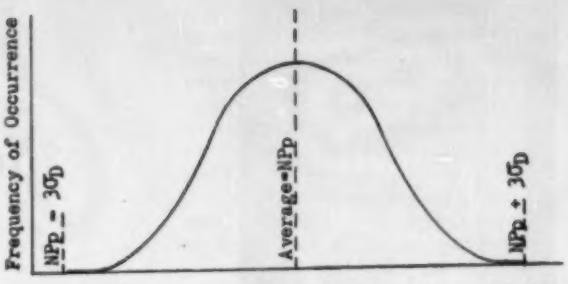

Figure 1

coefficient of $\sqrt{(N)(P)(p)}$. Let us denote this variable coefficient by "t", so that the distribution now becomes translated as shown in Fig. 2.

A comparison of Figures 1 and 2 shows that for every value of D there is a corresponding value of t, and that as t increases positively, the area included under the distribution curve also increases. For example, when $t = -2$, the area included under the curve below the boundary line is approximately 2 percent; when $t = -1$, the area under the curve below the boundary line approximates 16 percent; and 50 percent of the area is included when $t = 0$. Since the distribution curve is symmetrical, the same percentage factors are applicable in reverse as t continues to increase.

Fortunately, mathematical tables have been prepared which allow one to determine rapidly the corresponding percentage area for any value of t. By relying on another statistical theorem, we find that for our purpose $t = \frac{D - (N)(P)(p)}{\sqrt{(N)(P)(p)}}$, or in other words,

$t = \frac{\text{(Actual No. of Defects)} - \text{(Norm)}}{\sqrt{\text{Norm}}}$. Thus we have a very convenient method for computing t and determining its corresponding percentage area.

In fact, the ease of determining the percentage area by use of the normal distribution is a very important factor. It was stated earlier that the binomial expansion results in the most accurate portrayal of the distribution of D, and that the normal curve is merely an approximation to the binomial. If one desires the utmost accuracy and chooses to employ the binomial, the percentage area can be determined by obtaining the summation as follows:

$$\text{Percentage Area} = \sum_{m=0}^{D} C_m^{(N)(P)} (1-p)^{(N)(P)-m} (p)^m$$

(Concluded on page 14)

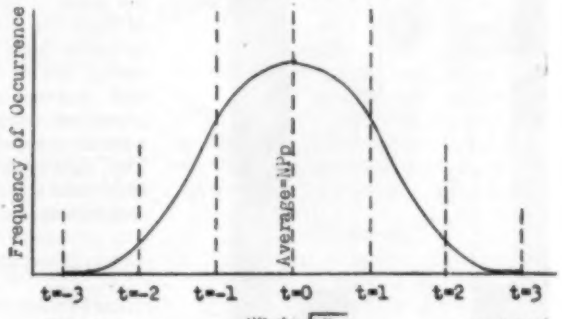

Figure 2

An Application of Quality Rating

G. GEORGIS

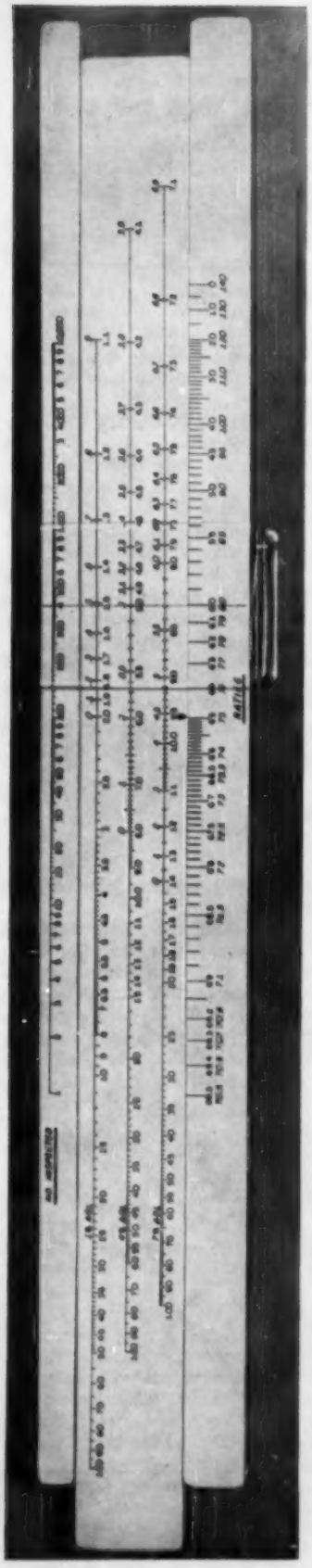

Figure 1—A Vendor Rating Slide Rule

The ever increasing emphasis on vendor relations has given rise to a number of vendor quality rating plans by which the quality performance of a vendor may be described by a single number or a group of numbers. One such plan is the Bendix Vendor Quality Rating System[1], the evaluation of vendor performance being in terms of an index dependent on the number of standard deviations the vendor's observed percent defective differs from the AQL.

There are many advantages to using a statistical computation as the basis for vendor evaluation. First, the use of a probability function is appealing to the quality control group since it takes into account normal variations in process average due to effects of sample size. Second, it provides a number that is not merely a "good" or "bad" indicator but tells "how good" or "how bad" the vendor is. Third, it provides a common basis for communication that minimizes the chances of misunderstanding since the quality index in its final form has definite predetermined acceptability limits and does not need reference to special tables or AQL's for its interpretation.

In order to fit the Bendix plan to the needs of the Revere Corporation of America, several changes had to be made both in the calculation of rating and in the IBM compilation and analysis of data. In the first place, we wanted a fast and simple way to compute "t"* and "V.R."†. The desk calculator and ordinary slide rule are not fast enough to be satisfactory, so we devised a special slide rule to perform the calculation. This special rule is constructed to give the Vendor Rating directly from the number inspected and the observed percent defective. It consists of a scale for number inspected, three scales—one for each AQL used—for the observed percent defective, and a scale for the Vendor Rating. By setting the hairline on the cursor to the number inspected and aligning the percent defective on the proper AQL scale with the number inspected, the vendor rating is read directly below the index on the slider. Figure 1 illustrates this instrument. The conditions for which the slide rule is set in this illustration are:

No. of pieces inspected	= 400
Percent defective	= 5 percent
AQL	= 4 percent
Vendor Rating	= 65

1. Line up hairline on cursor to 400 on the top scale (Marked "4" due to space limitations on scale).
2. Move Slider so that the 5.0 percent point on the 4.0 percent AQL scale lines up with the hairline.
3. Read Vendor Quality Rating below the triangular shaped index point. In this case VR = 65.
4. Had the percent defective been 3.0 percent, the setting would be the same except the Rating would be read as 75. Note that values of percent defective lower than the AQL are marked in slanted numbers as are values of VR above 70. Values of percent defective higher than the AQL are marked in vertical numbers, corresponding to VR's below 70.
5. The Slide Rule can also be considered as set for values of 5.7

*$t = (p - p')/\sqrt{p'(1 - p')/n}$;
p = Observed percent defective;
p' = AQL;
n = No. inspected

†V.R. = Vendor Rating = 70 − 5t. (Bendix calls this "Q.R." for "Quality Rating").

the Bendix Vendor System to a Small Plant

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and 8.3 percent defective on the 7.0 percent AQL scale and 0.5 and 1.5 percent (approx.) on the 1.0 percent AQC Scale, since all these combinations will give the same t value and ratings below the index point in the photograph.

Secondly, the computation of a rating for each lot seemed to be unnecessary in our case since acceptance or rejection of the lot was determined by the number of defects only, the lot rating having no bearing on the lot disposition. Therefore, it was decided to calculate only ratings for the AQL groups for all lots totalled for each vendor. At the end of each month all lots received from each vendor are totalled, the number of defects in the four categories —critical, major, minor and incidental—are totalled, and with the number inspected in each of these categories, a percent defective is determined. From these figures a rating is figured for each AQL group and an average rating computed. This average is the final vendor rating for the month.

Third, a minor change was made in the calculation of V.R. from the value of t. In the Bendix system, Vendor Rating = 70 − 10t, giving upper and lower 95 percent probability limits of 90 and 50 respectively. This was modified at Revere to V.R. = 70 − 5t in order to give upper and lower limits of 80 and 60, which thus gives the rating the semblance of a school report card, below 60 being poor, above 80 being good, with 60 to 80 being acceptable.

Finally, some changes were also made in the IBM recording and compilation of data. Due to the limitations of the IBM interpreter, it was found impossible to describe completely all the defects in the lot. One dimension might have several defects, such as oversize, undersize, out-of-round, tapered, etc. and many lots that were defective had more than one dimension or characteristic defective. It was decided, therefore, to forego the convenience of IBM in defect analysis and punch only one card per lot.

Each card contains the following information: part number, vendor code, date, lot size, number inspected to each AQL, number rejected to each AQL, disposition of lot, and a code describing the vendor's lot certification acceptability. In cases where defect analysis is necessary for corrective action, the receiving reports contain all the details of defects and are easily available for study.

It might be well to comment on the basic philosophy followed in conjunction with this plan. The approach was not to sort the "good" vendors from the "bad" but rather to provide a flow of communications to the vendors regarding their quality performance and then, only after reasonable time and effort had been expended, eliminate those who did not respond to this action. It was necessary in the beginning to give each vendor a complete description of our receiving inspection system and to acquaint him with our methods of random sampling. All vendors were provided with copies of our acceptance sampling tables and provided with the means of determining AQL's from the drawing information.

Naturally each vendor contacted had suggestions to make concerning the determination of the rating. The most frequent suggestion was that some sort of consideration should be given to the degree of difficulty in performing the job, since some parts require highly complex setups and close tolerances while with other items the reverse is true. The view taken by Revere on that point is that the degree of difficulty of fabrication is reflected only in the cost of the item, the required quality being an engineering determination that is relatively independent of factors that would make the manufacture of the item more or less demanding on the skills of the vendor. As was pointed out to the vendors, a gear with an eccentric pitch diameter, if assembled into one of our mechanisms is oblivious to the trials and tribulations of the manufacturer and whirls on its merry way, binding, wearing and vibrating, eventually causing the product to fail at an early age. The gear must either be made correctly or sorted out after manufacture, but in either case, cannot be allowed to continue on to assembly. Since the sorting in this case must be performed, there is really no point in allowing the fabricator a higher AQL than can be tolerated, thus causing the sorting to be performed by the purchaser. The sorting cost will be the same no matter who does it, but placing the burden directly on the manufacturer will provide incentive for reduction or elimination of the defect.

Since the installation of this rating plan, there has been increased activity by both the vendors and our own vendor liaison personnel in requesting and providing information necessary to the successful manufacture of detail parts and assemblies. Most vendors are *not* now willing to take the attitude of "ship it and see if they'll take it" on items of questionable quality. There has been a statistically significant improvement in overall quality in our incoming inspection, and the steady decrease of rejected lots over the past six months is strong evidence of the continuing efficiency of the system.

A final thought on this system is that it is also applicable to within-plant departmental ratings. The very nature of the number makes it ideal where greatly varying levels of AQL or past performance exist. Since most of the departments in Revere have definite AQL's established on parts and processes, there appears to be no difficulty in setting up such a system. The benefits are similar to those derived from the system as applied to vendor control and the problems encountered in the initial setup appear to be about equivalent.

Reference

1. Fitzgibbons, Robert G., "The Bendix Radio Vendor Quality Rating System, *Industrial Quality Control*, Vol. XI, No. 8, May, 1955, p. 38

(Continued from page 11)

This summation often requires time-consuming calculations, which is a decided disadvantage when manpower or cost of application are factors which must be considered.

It was also stated earlier that the Poisson distribution may be used instead of the binomial, especially when (N)(P) is large and p is relatively small. If this method is desired, the percentage area can be found as follows:

$$\text{Percentage Area} = \sum_{c=0}^{D} \frac{e^{-(N)(P)(p)}[(N)(P)(p)]^c}{c!}$$

When values of (N)(P)(p) are less than 100, the percentage area may be determined directly from Table II of Molina's *Poisson's Exponential Binomial Limit* Tables. However, interpolation may often be required when using Molina's Tables, so that it becomes a matter of opinion regarding the economics of the application as contrasted to the normal curve method. There is no question but that both the binomial and Poisson models are usually superior insofar as accuracy is concerned.

6. Previously it was mentioned that in all instances a rating of 75.0 would always be equal to the norm. From the equation given for the normal curve application, it is seen that when D = (N)(P)(p), t = 0, and this is evidenced by Fig. 2. Since (N)(P)(p) is equal to the norm at all times, it is apparent that when t = 0, the rating is 75.0.

As D increases, thereby increasing t, we should by logic obtain a rating lower than 75.0. By the same token, as D decreases, we should expect a rating higher than 75.0. This is accomplished by the following equation:

$$\text{Rating} = 75.0 + \left(\frac{50.0 - \text{Percentage Area}_t}{2}\right)$$

To summarize, a quality rating using the above method may be determined by performing the three operations as listed below:

a. Compute t:

$$t = \frac{(\text{Actual No. Defects}) - (\text{Norm})}{\sqrt{\text{Norm}}}$$

b. Find the percentage area corresponding to t by consulting a Table of Normal Curve Areas.

c. Compute the numerical rating:

$$\text{Quality Rating} = 75.0 + \left(\frac{50.0 - \%\text{Area}_t}{2}\right)$$

Example:

Let us determine the Quality Rating for the top plate illustration quoted earlier, using the three methods described above.

Normal Curve

N = 60, P = 66 and D = 18. Assume that a percentage norm of ½ percent has been established. Therefore, (N)(P)(p) = (60)(66)(0.005) = 19.8. The calculation of t then becomes:

$$t = \frac{D - (N)(P)(p)}{\sqrt{(N)(P)(p)}} = \frac{18 - 19.8}{\sqrt{19.8}} = -0.4045$$

By consulting the table we find the percentage area associated with a t equal to −0.4045 is 34.29 percent. Therefore,

$$\text{Quality Rating} = 75.0 + \left(\frac{50.0 - 34.3}{2}\right)$$
$$= 75.0 + 7.9 = 82.9$$

indicating that the existing quality level is somewhat better than the norm.

Binomial Expansion

N = 60, P = 66, D = 18 and p = 0.005. The percentage area is found by obtaining the summation of the various terms of the expansion.

$$\text{Percentage Area} = \sum_{m=0}^{D} C_m^{(N)(P)}(1-p)^{(N)(P)-m}(p)^m$$

$$= \sum_{m=0}^{18} C_m^{3960}(0.995)^{3960-m}(0.005)^m$$

$$= 0.398077$$ (Value determined from the 19 terms by use of ten-place logarithm tables.)

Therefore,

$$\text{Quality Rating} = 75.0 + \left(\frac{50.0 - 39.8}{2}\right)$$
$$= 75.0 + 5.1 = 80.1$$

Poisson Distribution

N = 60, P = 66, D = 18 and p = 0.005. Therefore (N)(P)(p) = 19.8. The percentage area will be the probability of 18 or less defects. From Molina's Table II, for a = 19 and c = 19 read 0.530516, and for a = 20 and c = 19 read 0.618578. Using linear interpolation, the probability is 0.600966 for a = 19.8 and c = 19. Subtracting this value from 1.000000 results in the probability of 18 or less being 0.399034. Therefore,

$$\text{Quality Rating} = 75.00 + \left(\frac{50.0 - 39.9}{2}\right)$$
$$= 75.0 + 5.0 = 80.0$$

It is seen from the above calculations that the Quality Rating obtained using the normal model is somewhat higher than that resulting from the binomial, while the rating obtained employing the Poisson is slightly less. The reader may exercise preference regarding the method to be used, depending upon the accuracy desired. It should be noted that smaller values of N, P, and D, in conjunction with larger values of p may result in discrepancies of a somewhat larger magnitude than that shown by the example.

By following procedures similar to those outlined in Paragraphs 1 through 6, quality ratings for a particular unit over a period of time may be combined into an overall rating by considering the summation of N and the summation of D. Furthermore, ratings for several types of units may be combined into a common rating for a productive area or department, by taking into account the summations of the individual values for (N)(P)(p), D and N.

References

Molina, E. C., *Poisson's Exponential Binomial Limit*, D. Van Nostrand Company, Inc., New York, 1942

Dodge, H. F., "A Method of Rating Manufactured Product," *Bell System Technical Journal*, Vol. VII, Apr. 1928, p. 350-368

Bibliography

JOSEPH MOVSHIN, *Editor*

Assisted by the Editorial Committee, St. Louis Section, ASQC

9220 Old Bonhomme Road, St. Louis 24, Mo.

APPLICATION—
AUTOMOTIVE INDUSTRY

QUALITY CONTROL VITAL IN TORQUEFLITE PRODUCTION, by Joseph Geschelin (Automotive Industries, v. 115, n. 12, Dec. 15, 1956, p. 62-65)

This article, the third in a series on the Chrysler TorqueFlite Transmission Plant in Kokomo, Indiana, describes the production checks and inspections employed in the processing of the TorqueFlite transmission. Not S.Q.C.

APPLICATION—
TEXTILE INDUSTRY

GENERAL TESTS FOR BETTER MILL OPERATION, by Norbert L. Enrick, (Institute of Textiles Technology, Charlottesville, Virginia)

(Modern Textiles Magazine, Nov., 1956, p. 50-54)

This sixth quality control article on mill test procedure discusses Sizing Tests for Sliver, Roving, and Yarn; Roll Settings Check; and Drafting Roll Out-of-Roundness Check. Full details of equipment and methods of procedure are presented and illustrated. Forms for recording the data and evaluating it are given. Standards of acceptability and appropriate controls are described.

ENGINEERING & EXPERIMENTS

INSPECTION AND TESTING (FORUM ON TECHNICAL PROGRESS)

(Steel, The Metalworking Weekly, v. 140, n. 1, Jan. 7, 1957, p. 306-308)

This section of the Forum on Technical Progress presents a discussion of some of the problems, capabilities, and limitations of various non-destructive test methods. These include: X-ray and ultrasonics to examine metals and metal parts.

MANAGEMENT & PERSONNEL, GENERAL

QUALITY CONTROL AT OPERATOR LEVEL, by Joseph D. Shaffer (Parker Appliance Company, Cleveland, Ohio)

(Steel, v. 139, n. 22, Nov. 26, 1956, p. 112-114)

The author presents an inspection system wherein the frequency of inspection is determined by the cost of inspection compared with the cost of scrapping a part. Charts are developed indicating the number of parts to be inspected versus total cost. Instructions are included whereby an operator can find the inspection required for a given lot size of a given part. An example for a specific part is shown.

IDEAS LIKE THESE SIX WILL HELP YOU SLASH YOUR SCRAP LOSS, (Motorola—Chicago)

(Factory Management and Maintenance, v. 114, n. 11, Nov., 1956, p. 115-117)

A scrap reduction program at Motorola is described. The use of displays showing the cost and kinds of scrap is illustrated. Posters, "gags," and gimmicks are recommended. These include graveyard with tombstones for scrap and lollipops for production workers who beat their monthly scrap bogey.

NEW SLANT FOR SCRAP—DOWN!, (Jones & Lamson Machine Company)

(Factory Management and Maintenance, v. 114, n. 11, Nov., 1956, p. 96-97)

A scrap reduction program based upon a predetermined goal to be achieved over a period of time is described. Charts of total scrap cost and ratio of scrap dollars to standard hours is used. Weekly scrap reports are used to make the foremen and operators aware of scrap cost, goals, and improvements. The use of Quality Control "trouble-shooters" to correct chronic causes of scrap is indicated.

Selected references in the Bibliography of *Industrial Quality Control* are obtained from the following sources:

The International Statistical Institute, *International Journal of Abstracts on Statistical Methods in Industry.*

MISCELLANEOUS

DO'S AND DON'TS TO MAKE GAGES LAST LONGER, by Peter J. Sommer (Plant Superintendent, Size Control Company, Chicago, Illinois)

(Tooling and Production, v. XXII, n. 9, Dec., 1956, p. 67-69)

This article outlines the proper storage, cleaning, and use of mechanical gages. Rules for the use and care of equipment are outlined as lists of simple instructions.

STATISTICS

FACTOR ANALYSIS AS A TECHNIQUE FOR EXAMINING COMPLEX DATA ON FOODSTUFFS, by Roland Harper

(Applied Statistics, v. 5, n. 1, Mar., 1956, p. 32)

INDUSTRIAL MANAGEMENT

MAGNETIC MEMORY LINKS CONTINUOUS INSPECTION AND SORTING, by Thomas G. Slattery, (Vice President, Automation, Inc., Wellesley, Mass.) and Arthur Joyce (Mechanical Engineer, Oswego Falls Corp., Fulton, New York)

(Automation, v. 4, n. 1, Jan., 1957, p. 75-80)

This article describes an inspection and control system applicable to continuous process lines such as used in paper products, sheet metal, wire, tubing and textiles. Essentially, a visual inspection based on a light source and photoelectric cells is placed in the continuous line process. Through an electronic memory and actuating system, a rejection station is actuated at some point in the production process, generally several steps beyond the sensing stage. In the illustration described, boxes are scanned in the continuous paper roll but are rejected after the individual box has been formed. This is all done automatically and continuously using electronic sensing and control mechanisms.

A REGRESSION CONTROL CHART FOR USE IN PERSONNEL SELECTION, by Frank Sandon

(Applied Statistics, v. 5, n. 1, Mar., 1956, p. 20)

MODIFIED CONTROL LIMITS, by David Hill

(Applied Statistics, v. 5, n. 1, Mar., 1956, p. 12)

THE USE OF STATISTICS IN THE INVESTMENT OF FUNDS, by G. H. Ross Goobey, FIA, FIS.

(Applied Statistics, v. 5, n. 1, Mar., 1956, p. 1)

What's New?

ROY A. WYLIE, *Editor*

When inquiring about "What's New?" items, please mention INDUSTRIAL QUALITY CONTROL

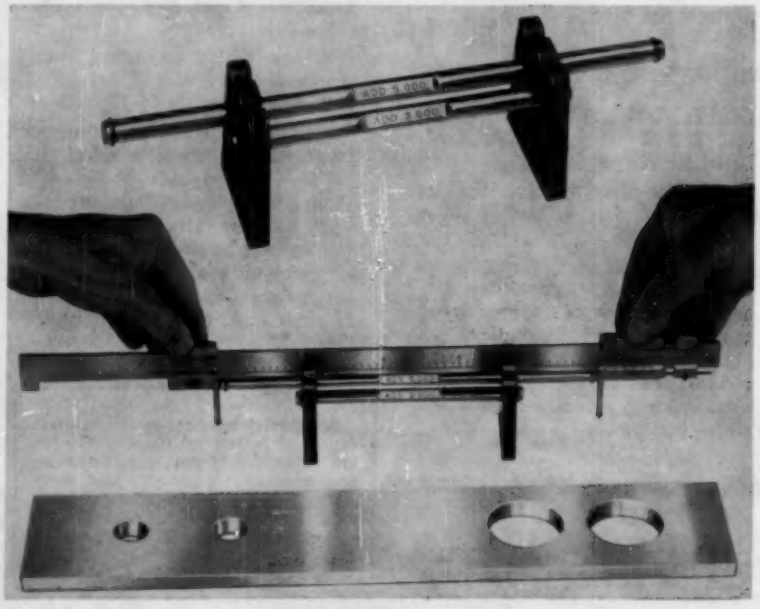
The Sheffield Corp., Dayton 1, Ohio has introduced a new thread checker capable of checking and indicating pitch diameters of any threaded part having external screw threads up to 1½ inches in diameter and of any specified pitch. The new instrument requires no special wires or attachments and can be quickly and simply operated mechanically to obtain pitch diameter readings from 0 inches upward on a large, easily read dial graduated in 0.0001 inches. For finer measurements the Sheffield Thread Checker may be adapted for use with Sheffield single column Precisionaire air gages and Plunjet air gaging cartridges or with the company's new electronic Accutron Amplifier and Electrojet Pick-up Unit. The device uses one pair of gaging tips for each pitch of thread to be checked. These tips have threaded shanks and are interchangeable to check virtually any pitch of any straight screw thread. The operator may select either a 16 oz. or 40 oz. gaging pressure and other gaging pressures are available to meet special requirements. Setup is made from a master thread plug or a previously calibrated part.

★ ★ ★

Sorensen Center-Mikes, Inc., 264 Kossuth Street, Bridgeport 8, Conn. announce the Booster-Bar, a new accessory to permit measuring greater center-distances with Center-Mike hole-location gages. There is a Booster-Bar for each of the 3 standard center-mike sizes. The largest Booster-Bar adds 9 inches to the measuring range of the A12 center-mike, raising it from 12.4 to 21.4 inches. Each booster-bar assembly has two precise-length rods held in plastic brackets that are slotted to hold the center-mike in the second step of the measuring sequence. The two rods, one long and one short, give coverage for all combinations of hole diameters and center spacing from the normal range limit of the center-mike alone to the extended range limit supplied by the booster-bar. The booster-bar allows unhampered freedom in adjusting the center-mike to the work. The center-mike which was introduced in 1952 is the only instrument that gives a direct reading of center distance between holes regardless of hole size. A bulletin describing its operation and prices is available from the manufacturer.

★ ★ ★

A new instrument for testing the hardness of non-metallic coatings on metal has been developed by the **Crown Cork & Seal Co., Inc.**, Baltimore, Md., and is being manufactured by Gardner Laboratory, Inc. of Bethesda, Maryland. This machine was especially developed to measure hardness of organic coatings on bottle crowns and cans, and on lug and continuous thread closures. However, the instrument was found to have considerably wider applications encompassing virtually the entire field of metal coatings. The stylus rests on the surface of the sample being tested and is linked by electronic circuit to an electronic tube. A spool-shaped weight is applied in gradually increasing degrees to the stylus. When the weight is sufficient to cause the stylus to pierce the coating and thus establish contact with the metal of the speci-



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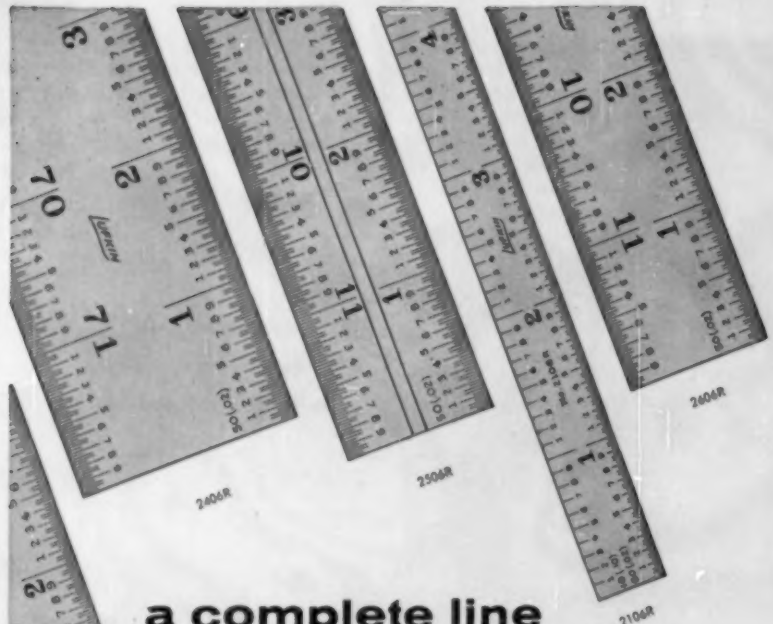

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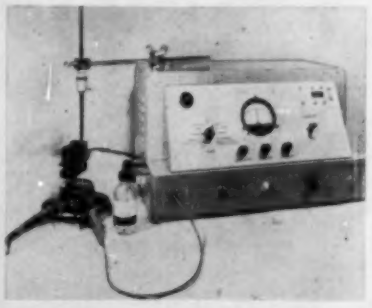
men surface, the electron tube closes a relay and a needle points to a figure on a scale. The figure represents the number of grams of weight required to break through the coating.

★ ★ ★

The Robert Marks Co., 47 Goddard Street, Providence, R. I. is now manufacturing gage points for standard and special gages of "Norbide" boron carbide. "Norbide" (boron carbide) is the hardest material commercially manufactured and is extremely resistant to wear. Cost is lower than either sapphire or tungsten carbide and these parts will last considerably longer than points of any other commercially manufactured material. They will remain clean throughout the entire useful life. Since they remain smooth and polished during use, they will not scratch work on any metal. The longer you use them, the smoother they get.

★ ★ ★

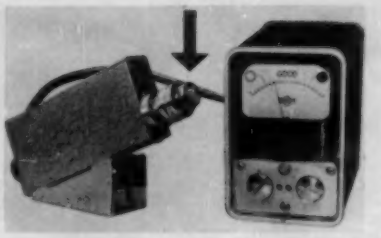


The Kocour Co., Department F-3, 4800 S. St. Louis Avenue, Chicago 32, Ill. have introduced the Model 955 electronic thickness tester. This unit determines the thickness of plating and other metallic coatings deposited over various metals and non-metallic base materials with an accuracy of 90 percent to 95 percent.

Readings are direct. A multiple position switch indicates the plating to be tested. The thickness of decorative and heavy chromium, silver, tin, cadmium, zinc, copper, brass, nickel, lead, lead-tin, and tin-zinc alloy can be determined on steel, copper, brass, aluminum and other metals, and on non-metallic materials such as ceramics and plastics. A new calibration feature in conjunction with Kocour Thickness Standards ensures "Long term accuracy." The instrument can be checked at any time and a calibration adjustment will automatically correct high or low readings.

★ ★ ★

Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., announced a new Zeromatic pH meter, an automatic pushbutton instrument with drift-free amplifier which can be adapted for potentiometer recorder output, automatic temperature compensation and Karl Fischer titrations. The line-operated instrument features automatic correction for electronic zero drift and rapid push button control. It has from 0 to 14 pH scale range and two millivolt ranges, 700-0-700 millivolt range and the extended 0 to 1400 millivolt range. The extended range is particularly useful for oxidation-reduction titrations. Readings are accurate to 0.1 pH and reproducible to 0.02 pH. In addition the instrument employs a "standby" circuit which eliminates warm-up. The Zeromatic is left connected to the 115 volt source at all times on "standby". To make a pH reading, the READ button is depressed. Push buttons also control temperature compensation and selection of the appropriate millivolt range. For most applications a Beckman 4990-83 Glass Electrode and a Beckman 1170 Reference Electrode are used. These units are supplied with the instrument. A wide variety of other Beckman glass, reference, and metallic electrodes may also be used with the instrument.



Industrial Gauges Corp., West Englewood, N. J. have introduced a new high speed electronic inspection unit known as the IM-1 Minitron. It is available with a series of attachments for checking internal or external measurements of all sizes and types. The simple plug in console can be set up for any three selections of magnification from 0.000010 inch/Div. up to 0.0001 inch/Div. The circuit guarantees positive stability of readings without regard to temperature effects and permits lower investment cost and longer life than many other types of similar gages. It is designed to withstand rough handling in the shop without affecting its accuracy.

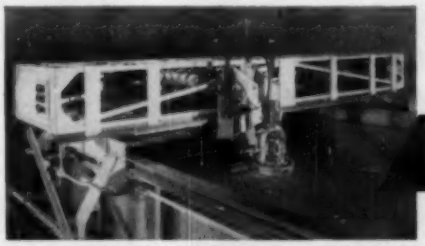
(Continued on page 25)

Finding the invisible with the inaudible

An engineer once said: "With ultrasonic inspection, you're finding the invisible with the inaudible."

Curtiss-Wright's Nondestructive Ultrasonic Test Equipment uses high frequency mechanical vibrations—far beyond the range of human hearing—for precision production-quantity inspection of forgings, rolled plate, welded tubing and other metal products. The "sound head"—immersed in water—sends vibrations that penetrate the metal under test and bounce back. Flaws show up on a cathode ray tube . . . and, simultaneously, a built-in alarm system sounds.

Curtiss-Wright Ultrasonic Inspection now controls quality for many leading producers in aircraft, steel, automotive, nuclear and other industries. Investigate its potentials for your production. Write for complete details.



Ultrasonic Immersion Test Equipment automatically scans wingskin plates for aircraft.

INDUSTRIAL AND SCIENTIFIC PRODUCTS DIVISION

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ASQC Convention Exposition Chart

AMERICAN SOCIETY FOR QUALITY CONTROL
11th ANNUAL CONVENTION • MASONIC TEMPLE • DETROIT, MICH.
MAY 22-24, 1957

DETROIT—City of the Straits • Motor City • ASQC Host City

In getting a little better acquainted with our Host City of Detroit, we have come across many interesting facts about this impressive city which may be new to you, too. . . .

For a bit of history, Detroit was founded in 1701 by Cadillac, who came down the waterway from Canada to found a town which would be France's gateway to the west. His original stockade, walled on four sides by 20-foot logs, was situated only a few feet from the site of today's Civic Center Park.

* * *

The name Detroit, translated from the French, means "City of the Straits"; strictly speaking, the body of water flowing past Detroit's doorstep, which we call the Detroit River, is not a river at all but a strait in the Great Lakes system, channeling the waters of Lake Huron through St. Clair on to Lake Erie. As the river passes Detroit, it jogs in its southbound course and runs west for several miles, carving out this fascinating geographical fact—standing at this point, you may look due south into Canada!—needless to say, the only place in the United States where you can do this.

* * *

Between the time of Cadillac's small pioneering craft and today, the Detroit River has become the world's busiest waterway. During the shipping season, the long flat-decked lake freighters pass at the rate of five an hour. The riverfront is also the major site of Detroit's vast new improvement program. Already complete in the downtown waterfront Civic Center—and a part of Detroit's impressive skyline—are the Veteran's Memorial Building, the 20-story City-County Building and the Henry and Edsel Ford Memorial Auditorium, home of Detroit's Symphony Orchestra. A 72-acre park and promenade, fronting on the Detroit River, comprises a scenic setting for the Civic Center group.

* * *

Besides being Detroit's business artery, the Detroit River is also its great playground. The world's greatest concentration of pleasure craft floats on the river and on its Lake St. Clair extension—more than 50,000 sail, outboard and power boats. Also in the river is Detroit's beautiful and famous park, Belle Isle.

The statistics on Detroit's activities as the Motor City are staggering. For example, in and around Detroit are no less than 13 factories assembling complete automobiles or trucks (all welcome visitors). And nearly two-thirds of America's output of Automotive parts and components flows from Detroit production lines!

* * *

However, even if an automobile had never been made here, Detroit would be one of the world's great industrial cities. In a bird's-eye view of the city's tremendous industry, we find that Detroit ranks at or near the top in the manufacture of business machines; pharmaceuticals; steel; heavy chemicals; diesel, aircraft and stationary engines; refrigerators; stoves; farm implements; machine tools and accessories; tires; paints; and foundry products.

* * *

For the social side of life, you will find that Detroit has excellent restaurants and night clubs, serving meals and entertainment for every taste. Easily available, too, are lively nightclubs just across the river in Canada.

A word of thanks now to the Detroit Convention and Tourist Bureau—we're very grateful to them for supplying us with this information. We'll see you in Detroit!

SCHEDULE OF EVENTS

11th Annual Convention—The American Society for Quality Control
Masonic Temple • Detroit, Mich. • May 22-24, 1957

Headquarters Hotel **Sheraton-Cadillac**

All Technical Sessions, Exposition & Luncheons

Masonic Temple

TUESDAY—MAY 21

4:00-9:00 pm	Advance registrants should pick up their tickets at the Registration Desk on the 4th floor of Sheraton-Cadillac Hotel.

WEDNESDAY—MAY 22

8:30 am	Registration: Cathedral Lobby of Masonic Temple.
	Special busses from Sheraton-Cadillac to Masonic Temple. 8:00-10:00 am, returning 3:30-5:30 pm daily.
8:30 am-5:30 pm	Exhibits
10:30 am-11:30 am	Technical Sessions
12:15 pm	Luncheon: Fountain Room. Guest Speaker, Dr. L. R. Hafstad, Vice Pres., Director of Research Staff, General Motors Corp.
2:00 pm-3:00 pm	Technical Sessions
3:30 pm-4:30 pm	Technical Sessions
4:35 pm	Annual Meeting, ASQC — Masonic Temple Cathedral.
9:00 pm	Social Evening, Crystal Ballroom, Sheraton-Cadillac Hotel (Not included in Registration; tickets must be procured separately.)

THURSDAY—MAY 23

8:30 am	Registration: Cathedral Lobby of Masonic Temple.
8:30 am-5:30 pm	Exhibits
9:00 am-10:00 am	Technical Sessions
10:30 am-11:30 am	Technical Sessions
12:15 pm	Luncheon: Fountain Room
1:30 pm	Plant Tours: Ford Motor Co., Cadillac Motor Co., Parke, Davis & Co., Plymouth Motor Co.*
2:00 pm-3:00 pm	Technical Sessions
3:30 pm-4:30 pm	Technical Sessions
6:15 pm	Annual Banquet: Grand Ballroom, Sheraton-Cadillac Hotel.

FRIDAY—MAY 24

8:30 am	Registration: Cathedral Lobby of Masonic Temple.
8:30 am-5 pm	Exhibits
9:00 am-10:00 am	Technical Sessions
10:30 am-11:30 am	Technical Sessions
12:15 pm	Luncheon: Fountain Room
2:00 pm-3:00 pm	Technical Sessions
5:00 pm	Convention closes.

LADIES' PROGRAM

Ladies' Headquarters during the entire convention. The Founders' Room, 4th Floor—Sheraton-Cadillac Hotel.

WEDNESDAY—MAY 22

9:00 am	Hospitality Hour, Ladies' Headquarters.
3:00 pm	Fashion Show — Afternoon Tea — Detroit Women's Club.
9:00 pm	Social Evening: Crystal Ballroom, Sheraton-Cadillac Hotel. (Not included in Registration; tickets must be procured separately.)

THURSDAY—MAY 23

9:00 am	Hospitality Hour, Ladies' Headquarters.
10:00 am	Trip to Greenfield Village — Dutch Treat Luncheon at Dearborn Inn — return to hotel by 4:00 pm.
6:15 pm	Annual Banquet, ASQC — Sheraton-Cadillac Hotel Ballroom (Not included in Registration; tickets must be procured separately.)

FRIDAY—MAY 24

9:00 am	Hospitality Hour, Ladies' Headquarters.
10:00 am	Several optional extra cost trips available to special interest locations.

*The following page brings you highlights of the Plant Tours and the Exposition.

PLANT TOURS

11th Annual Convention—The American Society for Quality Control
Masonic Temple • Detroit, Mich. • May 22-24, 1957

PLYMOUTH DIVISION, CHRYSLER CORP.

In a tour of the Plymouth "Qualimatic" V-8 Engine Plant, convention members will be able to observe how Plymouth has applied new concepts of quality control and manufacture, thereby cutting by two-thirds the normal three-year program for designing, developing and producing its V-8 engine. At this "Qualimatic" (meaning quality control through automatic processes) plant, production is set for 150 engines per hour, or triple the capacity of the previous plant.

CADILLAC MOTOR CAR DIVISION, G.M.C.

On the final assembly line of the Cadillac Motor Co. plant, the various parts fabricated, machined and processed by the manufacturing division meet. Visitors may watch the Cadillac craftsmen along this quarter-mile line apply exacting standards of accuracy in combining these parts into finished cars. The most dramatic point on this final assembly line, of course, is the moment when the automobile body is joined to the chassis and the final product emerges—inspected, polished and ready for its new owner.

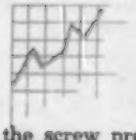
PARKE, DAVIS & CO.

A visit to Parke, Davis & Co. will be of special interest to all quality control engineers, not only those in the pharmaceutical field. This ninety-year-old firm is one of the world's largest pharmaceutical and biological manufacturers, with branches throughout the world. In the Detroit laboratories, the visitor can watch tablets, capsules and medications being made and packaged to the most exacting standards and by application of unique production features.

FORD MOTOR CO.

The Ford Motor Car Co. joins the local automobile manufacturers in offering a choice of plant tours. You are cordially invited to visit the fabulous Rotunda—one of the country's outstanding attractions. The Rotunda visit may be followed by a tour of the Dearborn Engine Plant where you may watch Ford, Mercury and Lincoln engines being assembled, or the Dearborn Assembly Plant where you will see a new Ford roll off the assembly line every minute. If your schedule permits, you may visit all three locations. Also nearby is the famous Greenfield Village.

LOOK FOR THESE FEATURES AT THE EXPOSITION



In their exhibit **The Bristol Co.** will illustrate how their line of socket screw products is quality controlled from receipt of raw material through finished product packaging. This will be accomplished by means of a flow diagram of the screw production lines and examples of statistical control sheets, actual small gages and representations of larger instruments and gages used in the manufacturing process.

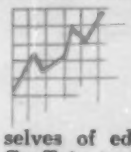
The Dow Chemical Co. exhibit will be of great interest to convention members as this company plans to show the various quality control methods which they employ to maintain high production standards. The accent here will be on quality control itself rather than on the Dow products—their highly diversified line of chemicals and plastics.

A new precision gage, the PG-800, will be a special feature of the **Sunnen Products Co.** who point out that the instrument is portable, requires no connections and has built-in wear compensation. Range is from .370" diameter to 1.500" diameter.

The Electromark Corp. states that their equipment marks any metal permanently, quickly and economically without distorting the surface. Their product display will include power supply units to deliver the small amount of current necessary, electrolytes which cause a chemical reaction with the metal, and stencils which allow the design to be reproduced on metal.

In addition to displaying and demonstrating their latest model—the Deci.Matic—which is said to be the first and only calculator with fully automatic decimals, **Marchant Calculator, Inc.** will display machines, charts and photographs illustrating the Marchant quality control program, parts boards and sub-assemblies.

Lectures, conferences, interviews and dictation may now be recorded at a 60-foot radius with Walkie-Recordall, Briefcase-Conference-Recorder, a lightweight, self-powered, battery-recorder-transcriber which will be demonstrated by the **Miles Reproducer Co.**



Friden Calculating Machine Co. Inc. will present a pictorial and product display of Friden's role in data processing, as related to summary and analysis for statistical quality control. Convention visitors may also avail themselves of educational matter on Standard Deviation, Coefficient of Correlation, Probable Errors, Etc.

You can join these successful exhibitors at this tailor-made market for quality control products and services. For space and information, contact—

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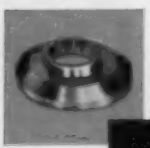

Send part print showing all dimensions to be checked and tolerances required for prompt quotation and delivery.

To speed inspection of production parts, new Dearbornaire air gaging instruments are now offered in multiple column units designed to permit more accurate simultaneous checking of as many dimensions as may be required for a given part. What's more, each unit incorporates all of the advanced design features which have made Dearbornaire the most practical, most versatile column type instrument ever produced . . .

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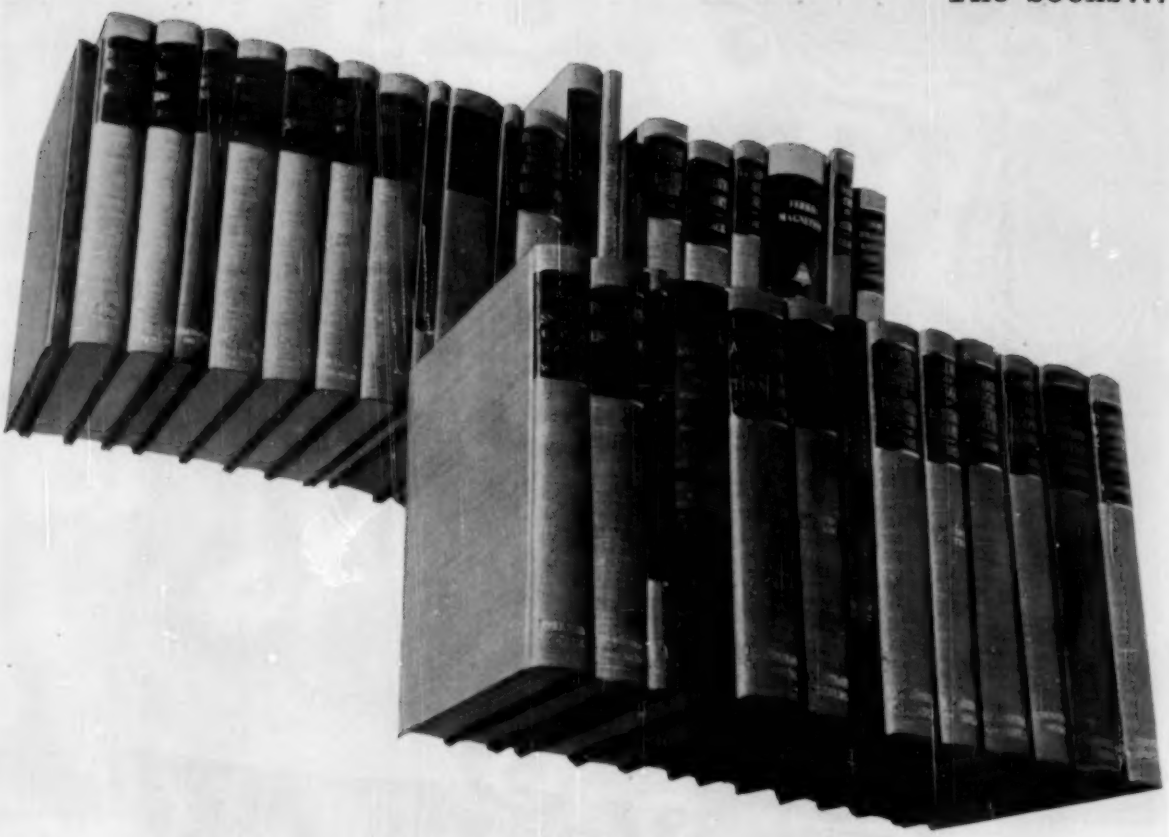
The books...



How the scientific world shares in fruits of the telephone art

In their work to improve telephony the scientists and engineers of Bell Telephone Laboratories make important findings in many sciences. They thoroughly report these findings in professional journals and magazines. But sometimes, as knowledge accumulates in a vital field, a "treatment in depth" is prepared in book form.

Bell Laboratories authors have written 36 books to date and others are in preparation. Many have become classics in the Laboratories' primary field of communications. Many have become standard works of wide application because they provide a fundamental guide for technologies in other fields. For example, the design of automatic switching systems is of primary importance in computers; statistical quality control provides the indispensable basis for economical manufacture. Through their books these scientists and engineers and the Laboratories attempt to repay benefits they receive from the published works of others.

The pictures on the opposite page show some Bell Laboratories authors of technical books. A complete listing of titles may be obtained by sending in this coupon.

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Most of the books written by Laboratories authors are published by D. Van Nostrand Company. Other publishers include John Wiley & Sons and McGraw-Hill. Subjects include speech and hearing, mathematics, transmission and switching circuits, networks and wave filters, quality control, transducers, servomechanisms, quartz crystals, capacitors, visible speech, earth conduction, radar, electron beams, microwaves, waveguides, antennas, traveling-wave tubes, semiconductors, ferromagnetism.

Harold S. Black, B.S. in E.E., Worcester Polytechnic Inst., author of "Modulation Theory."

John R. Pierce, Ph.D., California Inst. of Tech., author of "Traveling-Wave Tubes."

Richard M. Bozorth, Ph.D., California Inst. of Tech., author of "Ferromagnetism."

W. Thornton Read, M.S., Brown University, author of "Dislocations in Crystals."

Hendrik W. Bode, Ph.D., Columbia University, author of "Network Analysis and Feedback Amplifier Design."

Walter A. Shewhart, Ph.D., University of California, author of "Economic Control of Quality of Manufactured Product."

Four new portable, industrial X-ray units for the radiographic inspection of castings, welds and assemblies have recently been announced by **Mitchell Radiation Products Corp.,** 128 East Washington St., Norristown, Pa. Three of the units are designed for heavy duty work while the fourth unit is a small trepanning unit for spot examination of welds and light radiography. The units are dustproof, waterproof and shockproof. Other protective features include a thermal relay for overload protection, a flashover relay to prevent operation of the unit in case of surges; a voltage sensitive relay to prevent the accidental application of excessive voltage to the transformer and X-ray tube and a thermal switch in the X-ray head to prevent operation of the unit at excessively high oil temperatures. Maximum steel penetration for the MS-200 is 2¾ inches; MS-260, 4 inches; and MS-300, 5½ inches. Maximum power consumption is 1050 watts, 1450 watts and 1700 watts respectively.

★ ★ ★

A new idea in solid "GO" and "NO GO" internal gages is introduced by the **George Scherr Co.** The "Holojust" Adjustable Hole Gage is of simple construction and of practical usefulness. Used as adjustable limit plug gage, the "Holojust" will check the bore diameter as well as out-of-roundness and bell-mouth in any spot and any depth depending on the length of the handle up to approximately 5 inches. The full set of gages will cover a total range from 7/16 to 2 9/16 inches at a saving over the cost of solid plug gages. Single gages are obtainable. Gages are easily adjusted to any limit by means of micrometers or gage blocks. The price for the complete set of 5 gages in case is $39.50.

★ ★ ★

The L. S. Starrett Co., Athol, Mass. has introduced the Starrett #123 Satin Chrome Master-Vernier Caliper. The new 50-division Vernier with widely spaced, easy-to-read graduations is used to simplify setting and reading without the use of a magnifying glass. This feature permits having half the conventional number of graduations on the bar which further assists in fast accurate reading. The tool is designed with both vernier plates fitting flush with the main scale, thus eliminating reading errors due to parallax. The new open-face design also permits placing both the inside and outside Vernier scales on the same side of the tool. The caliper is held and read exactly the same for inside and outside measurements. All reading surfaces of the gage are finished in Satin Chrome and other surfaces are hard chrome plated for resistence to rust and stains. The Caliper is available in 12" and 24" sizes graduated in thousandths.

★ ★ ★

The Lenox Instrument Co., 2010 Chancellor Street, Philadelphia 3, Pa. manufactures a line of industrial periscopes that can be used in many industries for the remote observation of inaccessible places and the study of hazardous processes from a

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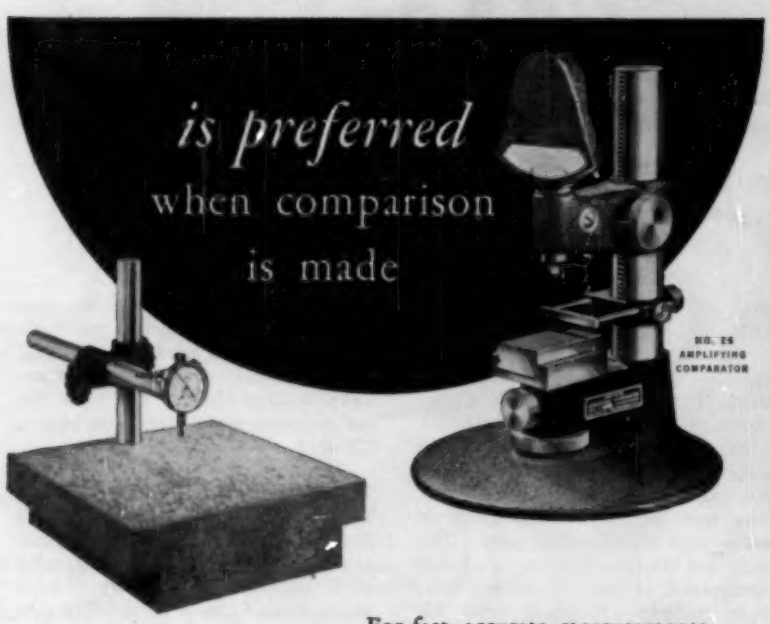
when comparison
is made



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safe viewing distance. The instruments are designed to go through walls and contaminated or explosive atmospheres, around corners and under or over obstructions to permit the study and control of some phase of industrial work from a remote point. The units consist of a series of lenses and prisms usually encased in a tubular unit containing various angular bends. They may vary in size from that of a short quill to over 60 feet in length and provision for high pressures, temperatures and harmful radiation can be furnished.

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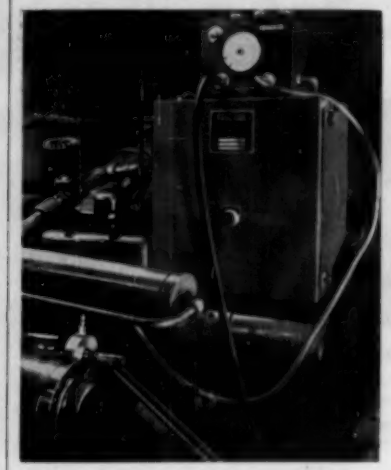

Federal Products Corp., 1144 Eddy Street, Providence 1, R. I., has announced a new continuous measuring gage for centerless grinding machines. It continuously measures the output of various types of centerless grinders and visually indicates any trend toward out-of-balance work so that as many as three or four machines can be easily and adequately supervised by a single operator. So that the gage will respond to workpiece size only, ignoring local irregularities such as spaces between workpieces, oil holes, annular grooves, etc., the gage incorporates time delay response which is adjustable in accordance with the speed of work travel and piece length. This time delay provision produces a steady uninterrupted signal which clearly indicates the condition of the work without interfering with detection of trend toward borderline work size. The gage can be equipped with audible signals if desired. The gage consists of an air snap gaging head or an air ring gaging head attached to an Air-Electric system with dial graduated in 0.000050 inches.

★ ★ ★

An automatic, probe-type monitoring system for checking the root diameters of external splines or keyways on drum type parts has been added to the 3-Way gear classifier line developed and built by **Michigan Tool Co.**, 7171 E. McNichols Road, Detroit 12, Mich. The new unit uses a gaging action based on "point contact" of individual probes. These pre-set probes, by means of a controlled indexing, will check any or all root diameters of a part on a 100 percent basis. This model is designed for integration into automated production lines, particularly those lines using the Michigan Tool system. Oversize, undersize, and correct-size splines or keyways produced on hobbers, shapers, shavers, or Shear-Speed machines are gaged automatically using the root diameter as a reference base. A two-point contact system—a lower stationary probe and an upper "floating" probe—measures 100 percent production from a single machine or a bank of machines. Both a visual and electrical check of production accuracy is provided within the specified tolerances of the spline root diameter.

★ ★ ★

NEW LITERATURE

The Reska Spline Products Co., P. O. Box 4632, Detroit 34, Mich. has just completed a new catalog outlining their complete services for the manufacture of Involute Spline Gages, Serration Gages, Straight Spline Gages, Master Gages, Master Gears-Spur & Helical, Snap and Contour Gages, Built-up Gages and Fixtures, Punches and Dies, Arbors—Work and Inspection.

The complete line of Hunter Mechanical Force Gages is described in detail in Bulletin 750C, just published by the Hunter Spring Co., 1 Spring Ave., Lansdale, Pa. This brochure gives complete specifications for each of the company's eighteen precision, direct reading gages, which can be used for measuring both tension and compression loads up to a maximum of 200 lbs.

The Helicoid Gage Div., American Chain & Cable Co., Inc., Bridgeport 2, Conn. has prepared bulletin DH-23, a 4 page folder that features the manufacturer's line of pressure and chemical gages.

The Jarrell-Ash Co., 26 Farwell Street, Newtonville 60, Mass., has made available a 2-page bulletin describing the company's new SEIDEL CALCULATING BOARD for evaluating photometric data from spectrographic films and plates. Through the use of the Seidel transformation principle, the JAco SEIDEL CALCULATING BOARD eliminates much of the labor involved in constructing spectrographic emulsion calibration curves, and transforms the usually encountered logarithmic curves into easily interpreted, nearly straight lines. Among the features incorporated into the unit is a separate sliding scale which permits background corrections to be made directly.

Standard Gage Co., Inc., Poughkeepsie, N. Y., has made available an 8 page bulletin on *Dial Snap Gages*. This bulletin affords a basis for selecting the type best suited for a specific job or most desirable from a general purpose standpoint. Included is an explanation of Paralloc, a mechanism for maintaining parallelism of anvil faces.

REPORT OF NOMINATING COMMITTEE

The Nominating Committee has given careful consideration to all persons suggested for the American Society for Quality Control elective positions for the year 1957-58 and recommends the following slate.

For President:

Leon Bass
General Electric Company
Cincinnati, Ohio

For Vice Presidents:

Henry J. Becker
American Steel & Wire Div.
U. S. Steel Corporation
Waukegan, Illinois

Clarence R. Burdick
Houdaille Industries, Inc.
Detroit, Michigan

C. E. Fisher
Bell Telephone Laboratories
New York, New York

Ellis R. Ott
University College
Rutgers University
New Brunswick, New Jersey

For Executive Secretary:

Leslie S. Eichelberger
A. O. Smith Corporation
Milwaukee, Wisconsin

For Treasurer:

J. Y. McClure
Convair
Fort Worth, Texas

Each of these persons has been contacted and has agreed to allow their names to be placed in nomination and to serve if elected.

BOOK REVIEWS

W. D. Baten, Editor

26 University Drive, East Lansing, Mich.

HANDBOOK OF INDUSTRIAL STATISTICS by Albert H. Bowker and Gerald L. Lieberman, XII plus 232 pages, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1955, price $5.00. Reviewed by W. D. Baten.

This book is a reprint of the section on industrial statistics in the *Handbook of Industrial Engineering and Management*, edited by W. G. Dreson and E. L. Grant.

In this publication will be found ideas pertaining to the following: importance of histograms; description of the normal distribution; the binomial distribution; Poisson distribution; quality control charts for sample averages, ranges of samples, standard deviations of samples, fraction defectives, number of defective articles, defects per unit; how approximate normal distributions arise from sample averages from non-normal distributions; relation between control limits and engineering limits; relation of control charts based upon variables and those based on attribute data; sampling inspection; operating characteristic curves; how to choose a sampling plan for single, double, sequential and continuous sampling plans; curve fitting; correlation; problems of estimation and confidence limits; method of least squares; non-linear regression; analysis of variance; many different one-sided and two-sided tests for significance; variable sampling plans that match MIL-STD-105A plans; and test of independence in a two-way classification.

The authors presented clearly: significance testing for the value of a specified parameter; significance

testing for the comparison of two populations; the test of the hypothesis that the mean of a normal distribution has a certain value when the standard deviation is known and when unknown; the test of the hypothesis that the variance of a normal distribution is equal to a certain value; the test of the hypothesis that the means of two normal distributions are equal when the standard deviations are known and unknown but equal and not equal; the test of the hypothesis that the variances of two normal distributions are equal; estimates of confidence intervals; significance tests for regression coefficients; significance tests for percentages; significance tests for homogeneity of variances and Chi-square tests. This portion of the book with the many O. C. curves used in these tests, and its condensed summary tables, is illustrated with many applications and forms a large part of modern statistics.

The chapter concerning curve fitting is well explained with examples, computational procedure, underlying principles, estimates of predicted values of the dependent variable and methods of testing the regression coefficients.

The last chapter treats of the analysis of variance where are presented methods of solving one, two and three classification designs, together with explanations for analyzing Latin squares. Randomization tests and estimating variability due to the source are explained. Every detail is shown through well chosen examples of how to secure the various sums of squares for each design, together with mathematical models for each analysis. Methods are given for testing significance between all possible means by using some of Tukey's tables, after illustrating the use of F-tables. Components of variances are discussed.

This book contains a wealth of important tables as areas under the normal curve, factors for computing control lines, Poisson distributions, Dodge-Romig single and double sampling tables, MIL-STD-105A-tables, tables for values of np, percentage points of the t-distribution, percentage points of the χ^2 distribution, the 0.10, 0.05, 0.025, 0.01, 0.005 and 0.001 percentage points of the F-distributions, table of factors C* 0.05 and 0.01 significant levels), tables for showing variable sampling plans that match MIL-STD-105A plans, upper percentage points of the ratio S^2 max/S^2 min in a set of k mean squares for 0.05 and 0.01 levels.

There are many O. C. curves, worksheets for analyses of variance, summary tables for the various tests and a nomogram for the number of cases required for comparing two percentages.

This book contains a great deal of valuable information and will prove to be an excellent guide for solving many industrial statistical problems. I recommend it without reservation.

Local Section News

"... BUT NOT FORGOTTEN"

ALBUQUERQUE The Jan. 21 meeting was held at Mitchell Hall, University of New Mexico. The educational session was led by G. J. Lombardi, Sandia Corp., who began a four-session review of Charles R. Hicks' paper, "Fundamentals of Analysis of Variance."

Hugh P. Campbell, quality manager of the Glen L. Martin Co. of Denver, Colo., was the guest speaker. His subject, "Inspection during development and experimental programs," was based on experience with the R and D phases of the Tital missile program. His discussion of the integration of design, production, purchasing, and quality activities to attain desired reliability stimulated considerable interest in the audience.

The Community College of the University of New Mexico, in cooperation with the section, began an advanced course in statistical quality control. The 24-session course is being held each Tuesday night at the University and will run through Apr. 23.

ALLENTOWN-BETHLEHEM The regular January meeting, held on the evening of the ninth at Walp's Restaurant, Allentown, featured talks by section members on the application of quality control techniques to their own jobs. Much of the material presented was the direct result of training received in section spensored courses. The speakers were: Donald Yuteman, Dixie Cup Company; Richard Zwickl, Parish Pressed Steel Company; and Anthony Morfy, Atlas Powder Company.

BINGHAMTON The Jan. 8 meeting was held at the General Electric Co.'s Johnson City plant. A plant tour of the facility preceded the dinner and actual firing of the tail guns at the range was demonstrated for the group. The speaker of the evening was Society vice president Leon Bass of the General Electric Co.'s Jet Engine Dept., Evendale, Ohio. Mr. Bass gave a very informative talk on "Make it right the first time."

The meeting was most successful and was very well received by the members and guests.

At the present time, the section is sponsoring two courses running concurrently—one at the North High School in Binghamton in basic statistical quality control, and the other at the U. E. High School in Endicott in intermediate statistical quality control. There are approximately 25 students enrolled in each course and much enthusiasm for the classwork is being shown.

BOSTON In spite of dire warnings of a foot-deep snowstorm, which incidentally did not materialize, but caused the cancellation of many activities in Boston, the regular January meeting was held as scheduled on the 16th. There was a surprisingly good turnout of 29 to hear Mark Princi, manager of engineering at General Electric, West Lynn, discuss an engineer's impressions of quality control. In particular, he emphasized that the simplest statistical techniques are often adequate to assist in the solution of engineering problems and are especially valuable when they can be done

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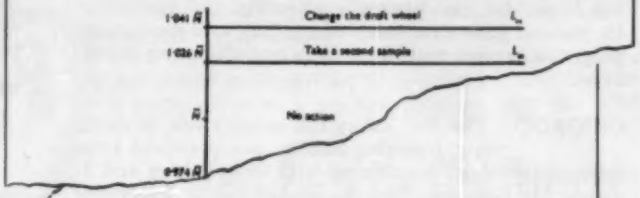
Subject:	Statistical control chart and operating characteristic curves for count in worsted spinning.	111:A1
TITLE:	Application of control charts to the control of count in worsted spinning.	
AUTHOR:	F. Monfort, Peltzer et Fils, Verviers, Belgium.	
JOURNAL:	J. Textile Inst., 47, P111-19, February 1956.	
PURPOSE:	To exemplify the use of control charts and associated statistical procedures in a worsted spinning mill.	
SUMMARY:	The establishment of a control chart for average yarn count ("metric count," km./kg.) decreased the number of process adjustments and reduced the coefficient of variation (CV). Operating characteristic (OC) curves for the test of count were derived and showed the desirability of increasing the number of test pieces (bobbins). The value of using statistical procedures is stressed.	
RESULTS:	A quality control chart for average yarn count, $\bar{x}$, was constructed using 95% confidence "warning" limits ("take a second sample") and 99.8% "action" limits ("change the draft wheel"). A generalized control chart for samples of five is shown in Fig. 1.	



ADVISORY BOARD: Milton Terry
Grant Wernimont

EDITORS: Robert S. Titchen, Arnold J. Rosenthal, Bruce Bollerman, Frank Nistico

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promptly so that valuable production time is not lost while making a decision. There was a good discussion group at the pre-meeting session. H. J. Davis discussed simple tests for significance.

The host committee for the 1958 Annual Convention to be held in Boston, under chairman Warren Grosjean, has started a series of meetings which will continue up to the time of the convention in May of 1958.

BUFFALO A joint meeting was held with the Buffalo section of the American Statistical Association on Jan. 30 at the University of Buffalo. The speaker of the evening was Maj. Gen. Leslie E. Simon, USA (Ret.), director of research and development, Carborundum Co. The General spoke on "Further observations on initiating a quality control group in an existing organization." An interesting discussion was held after the meeting on possible future training programs for statisticians and quality control personnel in the Niagara frontier area.

BUZZARDS BAY Fred J. Berkenkamp, consultant in the quality control engineering service department of the General Electric Co., Schenectady, N. Y., was main speaker at the Jan. 8 meeting. His subject was "Quality costs—a powerful measurement and programming tool." A dinner for the speaker at the New Bedford Hotel preceded the meeting. He discussed how quality costs provide a sensitive evaluation of the effectiveness of quality efforts in manufacturing, inspection, purchasing, engineering, and marketing. He showed means for establishing long and short range programs to meet overall needs in manufacturing operations.

CHICAGO The Fox Valley sub-group's Jan. 22 meeting, featuring Society vice president Leon Bass, achieved a fine turnout with 28 members and 32 guests. Mr. Bass described the vital elements of a vendor relations program, as well as refinements developed from his own experience. A lively question and answer period followed this presentation.

On a snowy January evening, members of the Calumet subsection met at Tiebel's Restaurant in Schereville, Ind., to hear Carl Jenkin's illustrated talk on statistical methods applied to plant safety. Safety experience, just like manufacturing experience, has been analyzed on control charts. It has been possible to determine the instant when causes other than mere "chance" contributed to the American Steel Foundries accident rate. Corrective measures could then be applied.

CINCINNATI The section's all-day conference was held successfully on Jan. 26 at the Netherland Holtin Hotel. Approximately 260 registered for the various sessions. A new sidelight was offered by Gabe Paul, vice president and general manager of the Cincinnati Baseball Club, in a remarkably interesting talk carefully interwoven with statistical references. One significant fact drawn from the conference was that there is still great need in this area for elementary education in statistical quality control methods—as the introductory groups were on every occasion filled to capacity.

CLEVELAND Robert D. Muir, chief inspector for Lundberg Screw Products was the speaker on Feb. 1. He gave an entertaining and enlightening talk on "The supplier and quality control." Drawing on his long experience he illustrated how cooperation between the customer and supplier can increase profit and quality for both.

COLUMBUS The January meeting was held at the Columbus Division of Westinghouse. Frank Caplan, director of quality control of the Atomic Fuel Div., Westinghouse, presented a very interesting and instructive talk on "Methods of rating vendors."

CORNING -ELMIRA The week of Jan. 7-12 was designated as "quality control at work" week by the section and activities for the week included a joint meeting with the local section of the American Chemical Society on Monday night featuring Cuthbert Daniel from New York City. Tuesday night, Robert Brickley of Westinghouse Electric Corp., Pittsburgh, spoke at the regular monthly meeting of the section, and on Sat., Jan. 12, an all-day seminar was held in the Corning Glass Center featuring members from the section speaking on the theme "quality control at work in the Corning-Elmira area." The combined attendance at the three meetings was over 230.

DALLAS -FORT WORTH A memorable evening was had by local members when Dorian Shainin described nine case histories illustrating his talk on "Breaking through industrial problem barriers." The January meeting was attended by approximately 70 members and guests. All agreed that the presentation of the versatility of statistical techniques—together with a sound program for attacking industrial problems—was ably demonstrated by Mr. Shainin as he showed slides of several "last

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chance" problems which harried manufacturers turned over to his concern for solution. The unique solutions involved a variety of standard statistical techniques plus keen observation, engineering "know-how", and good old common sense.

DANVILLE -SUNBURY The regular monthly meeting was held on Jan. 16 at the Visual Aids Auditorium, Bucknell University, Lewisburg, Pa. Dolph H. Taylor of the Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md., delivered a very interesting lecture on the subject of "Training for quality control."

DAYTON The Jan. 10 meeting was held at the Ranch House Restaurant in Dayton. The speaker for this meeting was J. A. Davies of the General Electric Co., Owensboro, Ky., whose talk on "Variables sampling without calculation" proved to be very interesting to all the members as well as the guests attending this meeting.

DELAWARE At the January meeting of the section, E. G. Wiest and H. C. Harris, both of Du Pont's Chambers Works, presented a paper jointly on "An interlaboratory study of melting range as a quality criterion for rubber chemicals." Dr. Wiest, as the chemist, explained the setting up of the experiment and Dr. Harris, as the statistician, explained the statistical analysis of the data. (The same paper was later presented at the Stevens Sumposium on Jan. 12.) Preceding the dinner and meeting, E. L. Niedzielski of Du Pont's Petroleum laboratory presented a discussion at the educational course. The subject of the discussion was "Regression analysis."

ERIE On Jan. 16 we visited American Sterilizer for a plant tour. In spite of zero weather and a blizzard, we had a splendid turnout. This was a replacement program after our January speaker was forced to cancel. "Oh my! The worries of a program chairman."

GEORGIA The section and the Atlanta group held a joint special meeting on Friday, Jan. 11, when Dorian Shainin of Rath & Strong, Inc., industrial consultants, Boston, Mass., presented an illustrated talk on "Breaking through industrial problem barriers." Following the discussion period, several members said that this was the best meeting in recent years.

At the regular monthly meeting of the Atlanta group on Jan. 29, Dr. Robert E. Serfling, chief of statistics section, U. S. Public Health Service, Communicable Disease Center, Atlanta, related "Some problems in applying mathematical theory to epidemics." It was interesting to see how the sampling and statistical theory of quality work is being applied to medical problems for the benefit of mankind.

GREATER MUSKEGON Thirty-nine members gathered at the Mona Lake Boating Club on Jan. 10 and enjoyed a social mixer. Nearly 60 pounds of shrimp were consumed by the gourmands. Instead of the usual speaker, a panel discussion on "Salvage operations" had been arranged by M. V. Pascavis, program chairman. Al Lindberg, Emanuel Hansen, Bert Taulbee, and John Hansen made up the panel. Mr. Pascavis served as moderator. The panel discussion proved very interesting and was kept on a jovial level by the humor of John Yates.

Joe Portencasa, membership chairman, reported at a recent board meeting that 39 members now belong to the group. This is a decided increase over the 1956

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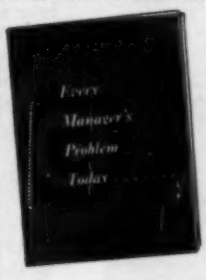

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membership and many points have been earned towards the Saddoris Award Competition.

HAMILTON On Jan. 16 a joint meeting was held with the University of Western Ontario section at the Brant Hotel in Brantford, Ont. This took the form of a dinner meeting and "management panel" whose subject was "Quality control from management viewpoint." Prior to the meeting a special publicity letter was sent out to the top management of all industries in the area, and the attendance was particularly good. Each member of the panel gave a brief talk and then the panel answered questions submitted in writing to the chairman, J. W. Jolly, general manager of Standard Tube & T. I., Ltd., Woodstock. Those questions were so numerous that the meeting had to be terminated before all could be answered.

HARRISBURG Paul Clifford of Montclair State Teachers College presented an interesting discussion on "The fundamentals of QC" at our January meeting at Hostetters Restaurant in Mt. Joy. Unfortunately we had a snowstorm that day so our attendance was not up to par, but those attending had a most enjoyable evening.

HUNTSVILLE At the first meeting to be held in Decatur, a film entitled "Quality control," produced by the Air Force, was presented. Lt. Arthur Nordstrum presented a paper prepared by Russell L. Ackoff of the Case Institute of Technology entitled "Operations research." From the large turnout and the increased interest shown it is hoped that our section will grow considerably by co-operation with the Decatur people on meeting locations and participation.

Recently the section was faced with the problem of a shortage of qualified speakers to address the group on various phases of quality control.

A method was devised whereby authorities in various fields of quality control were contacted and permission obtained for the use of papers written by these authorities and to be presented by members of the section. General papers were chosen for presentation in the current year.

Several papers have been presented in this manner. It is believed that sections who find themselves faced with similar problems could use this system to advantage.

KANSAS CITY John W. W. Sullivan, American Iron and Steel Institute, was the guest speaker at the January meeting. Mr. Sullivan found a high interest group among the users of steel mill products. A part of the discussion which followed his presentation was devoted to the demands by industry for ever higher standards. With the quality attained by recognized improved techniques and controls, there are still demands beyond those standards. Prior to the dinner, the educational committee presented the regular monthly clinic. Arnold Holtan, manufacturers representative, through a film "How else would you make it" and a display of products, presented the art of die casting.

LINCOLN R. D. Humphries of Cessna Aircraft at Wichita, Kans., was guest speaker at the Jan. 11 meeting. Mr. Humphries gave an interesting talk on "The application and results of SQC at Cessna." D. E. Hillman, editorial chairman of the "Aircraft Newsletter" and also of Cessna, accompanied Mr. Humphries and assisted in the question and answer session which followed the talk. Twenty-eight members and guests were present at the meeting.

LOS ANGELES An unusually large attendance was attracted to the January meeting which discussed "Control and inspection of incoming material." In the preliminary clinic, John Howell, who teaches at L. A. City College, delivered a "Review of sampling plans," emphasizing particularly the pitfalls associated with each plan when used without understanding its basic principles.

The after-supper program was m.c.'d by Kenneth B. Kilbourne. John R. Bly discussed control and inspection of incoming material from the point of view of an electronics equipment manufacturer, and Gardner L. Mason discussed the same problems connected with mechanical products.

The section assisted the San Bernardino section in its first inland empire QC conference held Jan. 26 in Riverside, Calif. The assistance took the form of providing four speakers: John M. Howell, Dr. Obert B. Moan, Dr. Leo A. Aroain, and Kenton R. Wilhite.

The section also supplied the speakers for the Jan. 21 session of a series of ten educational lectures being conducted by the L. A. chapter of the Society for Nondestructive Testing. Dr. Leo A. Aroian chaired the session. Dr. Leslie Ball opened it with a talk on engineering reliability and non-destructive testing, establishing the scope of reliability programs, and the general place of QC and non-destructive testing in reliability programs. Ray Crawford followed with a presentation on the basic QC techniques, including control charts and sampling. After a brief interval for dehydration, Frank

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Squires wound up the evening with a talk on the application of both the technical and management principles of QC in an electronic and manufacturing program.

LOUISVILLE Our own member Oscar Bishop and George White of Richmond spoke to us at the January meeting concerning quality control at Reynolds Metals. It is surprising what consistent material Mrs. Housewife demands in the foil with which she does so many tasks. Mr. Bishop is presently vice chairman of the metals technical committee of the Society.

MID-HUDSON Dr. A. S. Shultz, Cornell University, recently addressed the section on "Operation research." Dr. Shultz indicated that through application of hi-speed digital computers many phases of managements' decision making have been revolutionized.

MILWAUKEE Jan. 21 was a red letter day on our calendar. Jack Youden of the Bureau of Standards talked about the design of experiments in a very understandable way. The joint meeting with the local chapter of the American Statistical Association was a good idea too.

MINNESOTA Joseph Movshin, quality manager of the Piston Ring Division of Thompson Products, presented a provocative talk on "Motivation for quality" at the section's annual dinner meeting.

MONTREAL The Jan. 16 meeting was held at the Mechanics Institute. The highlight of this meeting was a panel discussion on "Statistical control of packaging and filling" by Dr. J. Hulse of the Defense Research Medical Labs, H. Kredentser of Sherwin-Williams, and Dr. P. Ferencz of Canada Packers, Ltd. The meeting was well attended despite the bad weather and a lively question and answer period was held after the meeting.

MUNCIE Our section started the year with a meeting in the Pine Shelf Room of the Pittenger Student Center. Edward Oakley of Delco-Remy favored us with an outstanding discussion of "Process capability." It was a down-to-earth presentation which captured and held the audience from start to finish.

NEW HAVEN Paul Olmstead of the Bell Telephone Labs, Whippany, N. J., was the guest speaker at the Jan. 15 meeting. His subject was "Quality control techniques in engineering and research." Mr. Olmstead discussed various applications of statistics in the laboratory.

The section's educational program got under way on Jan. 16. The instructor for the course entitled "Basic quality control" is Dave Albert of Avco Lycoming Division.

RHODE ISLAND The first of a series of courses leading to a certificate in quality control management engineering ended in January. The second series began in February and will be held for ten weeks.

RICHMOND, IND. The Jan. 17 meeting was held at the Leland Hotel. It was boss night and charter night. The charter was presented by members of the Indianapolis section, sponsor of the Richmond section. A panel discussion was held. Topics discussed were presentation of data, machine capability, specifications and tolerances, and economics and justification for QC. Guest chairman for the meeting was William Vissing of Indianapolis. Robert Brown, president of the Richmond section, served as toastmaster. Bosses were guests of the members for a smorgasbord dinner.

ROCHESTER Both the December and January meetings were outstanding. In December the group heard L. Kent Reitz, development engineer, Paper Service Div., Eastman Kodak Co., discuss "Fundamental applications of QC in the chemical industries." It was quite obvious that a great deal of thought and energy went into the preparation of this paper. Many colored slides and process photographs were used for illustration.

In January the group was addressed by C. G. Rittenhouse, Cine & Sheet Film Div., Eastman Kodak Co. Mr. Rittenhouse's approach to "Management reaction to SQC in production" is unusually well done. Some stimulating and thought provoking points were brought out with the suggestion that certain possible SQC applications be approached with caution.

Both Mr. Reitz and Mr. Rittenhouse can be recommended to the speaker's committees of other sections.

ST. LOUIS The section had a plant tour of the Owens-Illinois Glass Co. at Alton, Ill. on Jan. 18 which was most interesting and also educational to many.

SAN BERNARDINO The first annual inland empire QC conference, sponsored by the section, was held at the Mission Inn, Riverside, Calif., on Jan. 26.

The purpose of the conference was to acquaint industry with the benefits of QC and to provide an opportunity for quality control personnel to hear and discuss the latest control techniques.

Attendance at the conference was very gratifying. One hundred and twenty-two people were present, representing many different types of industry and business in Los Angeles, San Diego, Pasadena, Glendale, Burbank, Beaumont, Banning, Riverside, as well as the San Bernardino Valley area.

Pictured on the left is a view of the speaker's table during luncheon at the inland empire QC conference sponsored by the San Bernardino section. On the right is a general view of the luncheon guests at the conference which was held on Jan. 28.

An excellent group of speakers was obtained for this, our first annual inland empire QC conference. They were: John M. Howell, Dr. Obert B. Moan, James S. Laidlaw, Dr. Leo A. Aroian, and Kenton R. Wilhite.

There was lively participation in the question-and-answer period following each presentation. This attested to the interest generated among those present.

SAN DIEGO O. S. Olds presented a very informative discussion with the aid of slides on Ryan Aeronautical Co.'s applications of electronics, at the section's January meeting.

Fifteen local members attended the first inland empire QC conference at Riverside, Calif., Jan. 26. This conference was sponsored by the San Bernardino section.

Section members in attendance at the reliability symposium held recently in Washington, D.C., were Gordon Briggs and Dave Archibald.

SAN FRANCISCO BAY AREA Ninety-two section members and guests attended a dinner meeting in Hayward on Jan. 14 and saw films of the Pacific States Steel Co. operations. After dinner, most of the members and guests visited the plant of Pacific States Steel which was nearby.

SEATTLE Over 100 interested participants attended an all-day workshop session sponsored by the section on Jan. 26. Four problems of a general nature were discussed. These were establishing quality standards, operating a quality control program, quality control problems, and training employees.

Albert N. Schrieber, prominent Northwest business consultant, was the luncheon speaker. His topic was "Industrial development in the Puget Sound area."

SOUTH BEND -MISHAWAKA Management night was held by the section and 25 local companies were represented. The Chamber of Commerce and the committee of 100 sent notices of the meeting to their subscribers. Arthur Oniberg, assistant general manager of Bendix Missiles, spoke on "Modern management decisions." He outlined the use of statistics in helping management to obtain all the facts quickly and correctly.

The nominating committee to select a slate of officers for the section is; chairman Vince Nichols, John Atkins, Rochwell O. Carrier, Wm. A. King, and Ralph Von Osinski.

SOUTH TEXAS Dorian Shainin, industrial consultant with Rath & Strong, presented an excellent paper at the January meeting which was a joint session with the American Institute of Industrial Engineers. A dinner preceded the meeting.

SOUTHERN CONNECTICUT On Jan. 23 the section started two eight-week basic quality control courses. One class, under the instruction of A. Henry Morgan, meets Wednesday evenings in the Wright Technical School in Stamford, and the other group meets Wednesday evenings at the Hotel Barnum in Bridgeport with Howard Levenson instructing.

TOLEDO In January, the section again held their meeting at the Elks Club. Dr. J. H. Toulouse spoke on the subject of "Training in quality control." Plans were also laid for our participation in engineers' week in Toledo.

TORONTO On Jan. 9 J. N. Watson, British American Oil Co., talked to members and guests on the subject of operations research techniques used for cost control in refinery operation.

On Jan. 23 Harold Kempling and the Collins Radio players (Nat Perry, Fred Worsley, Bob Street, and Joe Rzesnoski) presented the Bonnie Small play "Sampling inspection" to an enthusiastic audience. The script humorously portrayed awakening of a chief inspector and industrial engineer to the advantages of statistical sampling. It was very well done and, as well as being entertaining, gave rise to an energetic question period. Bob Cardno m.c.'d the question period during which Walter Pukalo of inspection services, D. D. P., gave a very clear comparison of the opposing risk viewpoints embodied in Dodge-Romig sampling plans (low consumer risk) and MIL-STD-105A plans (low producer risk).

UNIVERSITY OF WESTERN ONTARIO A joint meeting between the Hamilton and University of Western Ontario sections was held in Brantford on Jan. 16. This meeting was in the form of a manager's panel. Fifty odd members and guests heard management views on quality control and discussed quality problems with these members of management. J. W. Jolly, general manager of Standard Tube & T. I. Ltd., acted as panel chairman.

The Kitchener group of the section held a meeting on Jan. 30 which 32 members and guests attended. The meeting was part of our educational series, and the speaker was Vance Ward, secretary of the Montreal section. Mr. Ward gave an interesting talk and demonstration on "Acceptance sampling."

WINDSOR The January meeting held in the Prince Edward Hotel was unique in that those present had the pleasure of listening not to one, but to two speakers. Willard Phillips, manager of quality control, and W. J. Gallagher, a member of the QC staff, described how the quality control and the engineering departments co-operated to "Engineer quality control," at the tractor implement division of the Ford Motor Co. The lengthy discussion period following their talks was ample proof that the subject was of interest to the audience.

YOUNGSTOWN The January meeting was held at the Youngstown VFW Building. C. G. Schelley, of the Do-ALL Co., was the speaker for the evening. Along with his lecture, the exhibit of "The story of measurement" was on display. The exhibit and lecture were enjoyed by all members and their wives who were guests at this meeting.

". . . CAST THEIR SHADOWS BEFORE"

ALLENTOWN -BETHLEHEM The April meeting will be held jointly with the local ASTE chapter at the Hotel Traylor, Allentown. Dinner, served at 6:30 pm, will precede the program for the evening. Miss Bonnie B. Small, of the Western Electric Co., will make the feature address of the evening.

BINGHAMTON On Apr. 9 the section will hear from J. B. Pringle, staff engineer of the Bell Telephone Co. of Canada, Ltd., who will speak on "Fundamentals of statistical quality control."

BOSTON Apr. 10 marks the return to Boston of an old friend—A. C. Rosander of the Internal Revenue Department. He will discuss applications of QC techniques to accounting and tax operations.

BUZZARDS BAY Axel U. Sternlof, quality control supervisor at the American Steel and Wire Co. in Worcester, Mass., will be main speaker at the Apr. 9 meeting to be held at the Continental Screw Co. in New Bedford. His topic will be "Quality control in the wire industry."

CHICAGO On Mar. 26 the Fox Valley sub-group will feature a talk by A. H. Benscoter on quality control in the metal working industry. The speaker serves as director of quality control for the Permaglass Division of A. O. Smith, at Kankakee, Ill. This meeting will be held at Club Arcadia, St. Charles, starting at 6 pm.

The central theme of our general meeting on Apr. 10 will be "Human relations in SQC." Dr. Harry Sagen, manager of production quality control for Abbott Laboratories will present to the group a review of his experiences in "Developing quality attitudes and pride of workmanship." William G. Collins, chief chemist for Johns Mansville Corp. at Waukegan, Ill., will give a pre-dinner talk entitled "Quality control people are people." This meeting will be held at the Chicago Furniture Mart, 666 Lake Shore Drive. It starts at 4 pm.

CINCINNATI Chairman Dave Birch announces that the first meeting of the applications committee will be held at the Mar. 20 meeting. The session will get underway at 5:30 pm with a specific problem to be discussed by the four members of the panel as well as any interested members. The applications committee is ready at this time to accept problems from the membership and, if desired, confidence will be respected. The regular technical session for the March meeting will have Ervin E. Schiesel, vice president of Mattatuck Mfg. Co., Waterbury, Conn., as the speaker on "Quality control and automation."

The Hamilton-Middletown subsection hopes to announce at its Apr. 17 meeting the attainment of full section status.

CLEVELAND Coming up on Apr. 5 is the plant tour through the Ford Motor Co. A large turn-out is expected for this long awaited event. "Statistical quality control as applied to in-process material" will be the theme of the program which is under the direction of Irwin DeGrote and his able associates. Complete details for this program will be announced soon through the local section.

COLUMBUS Our March meeting will be held on Thursday, the 21st, at the Diamond Power Specialties Corp. in Lancaster, Ohio. No formal program is planned but the management of Diamond Power promise a well conducted tour of the production and quality problems of a highly specialized industry. Diamond Power are the developers and manufacturers of an entirely new phase of industrial television.

CORNING -ELMIRA On Apr. 9 the section will meet at the Hotel Langwell, Elmira, to hear R. M. Hofstead, assistant to production manager, Bristol Laboratories, Inc., Syracuse, N. Y., who will speak on "Statistical applications in the antibiotic industry." A tour of the General Electric Plant in Elmira is also planned prior to the meeting.

DALLAS -FORT WORTH On Apr. 11 Henry J. Jacobson, QC manager for the capacitor division of the P. R. Mallory Co., will discuss the section on "Quality control by infiltration." The address by Mr. Jacobson is expected to arouse the interest of local men in the electronic, avionic, and related fields. The new Engineering Building at Arlington State College will be the meeting place with the time of the meeting set for 8 pm.

DAYTON The seventh regular meeting will be held on Mar. 28 at the National Cash Register Co. The speaker for this meeting will be J. Fred Verigan of the Crown Cork & Seal Co. His talk will be on "Stimulating operator interest in quality control."

The eighth regular meeting will be held Apr. 18 in the form of a plant tour at the G. H. R. Foundry in Dayton. The principal speaker for this meeting will be Kenneth Henry of the G. H. R. Foundry whose talk will be on quality control in a production foundry. Guests for this meeting will be members of the American Foundrymens Association.

DELAWARE The tour of the plant of the International Latex Corp. at Dover which was originally scheduled for March has been moved ahead one month and will take place on Apr. 4. The conducted tour will start at 2 pm. Following the tour the group will convene for dinner in Dover and after dinner, representatives of the Latex quality control team will discuss their procedures and answer questions from the floor.

ERIE Our April speaker at a date not set at this writing will be a well known quality controller, William P. Goepfert of Alcoa, Pittsburgh. His topic will

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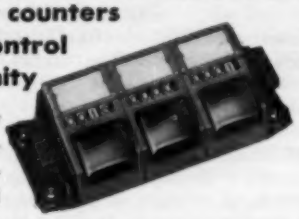

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GEORGIA The Atlanta group will meet on Tuesday, Mar. 26 at 7:45 pm, in Room 1127 of the Hurt Building, Atlanta, for a talk by E. G. Field on "High-low quality chart for individuals."

HAMILTON The regular March meeting will be held on the 21st in the Canadian Westinghouse Auditorium. The speaker will be Ben Lloyd, management consultant, Leetham, Simpson & Elliott, Ltd., Montreal, Que. His subject will be "Quality control and cost control."

HARRISBURG This year we will hold our annual panel discussion at our Apr. 3 meeting at Warner's Dairyland in Red Lion, Pa. As with most other sections, this meeting has proved to be one of our most informative and interesting of the year. Almost everyone seems to find some ideas and suggestions in hearing the other fellows problems and solutions.

KANSAS CITY The section will meet at the Blue Hills Restaurant at 6 pm on Wednesday the tenth for the regular dinner meeting. After the clinic session and dinner the section will meet Roy A. Wylie of Micro Switch Co. His subject will be "Analysis of variance."

LOS ANGELES The Mar. 21 meeting will feature Ervin E. Schiesel, vice president of engineering and sales of the Mattatuck Mfg. Co., Waterbury, Conn. Mr. Schiesel will discuss "Statistical cost control and analysis."

MID-HUDSON The local chapter of ASTE will be host to Mid-Hudson section at the annual joint meeting to be held on Apr. 2.

MILWAUKEE We'll be back at the Stratford Hotel on Apr. 15 to hear J. London of the International Harvester Co. talk about "Q.C., research and engineering." The dinner will be at 6:30 pm followed by the talk at 7:30. Good ole Milwaukee beer before the dinner.

MINNESOTA "The technique of preventing defects" will be Len Seder's subject at the regular April meeting of the section. Mr. Seder is nationally known as a quality control consultant and is co-author of the "Span Plan."

MONTREAL On Mar. 25 the section will hold a joint meeting in the C.P.R. Windsor Station, Allouette Room, with the Certified General Accountants Association. Claude Taylor of Trans Canada Airlines will talk on "Statistical approach to management controls."

MUNCIE On Thursday, Mar. 21, the section will hold a meeting in the Pine Shelf Room of the Pittenger Student Center. The dinner meeting will begin at 6:30 pm. A meeting at 7:30 pm will be addressed by Henry Jacobson. His subject will be "A study of inspection accuracy."

Due to the Easter holidays, our April meeting has been moved up to Thursday, Apr. 11. The usual 6:30 pm dinner meeting will be held in the Pine Shelf Room of Pittenger Student Center. Our 7:30 meeting will be addressed by G. W. Howard of Convair's Fort Worth Division. His address is entitled "An SQC program which speaks management language—dollars."

NORTHEASTERN INDIANA The section will hold its regular monthly meeting on Thursday night, Apr. 11, at the Fort Wayne Chamber of Commerce, Fort Wayne, Ind. Dr. Marvin E. Mundel, College of Business Administration, Marquette University, will speak on the applications of statistical quality control to motion and time study and other industrial engineering functions. The meeting will be a combined meeting with the American Institute of Industrial Engineering Society. It is anticipated that this will be a meeting which few will want to miss.

RHODE ISLAND On Mar. 21 Fred C. Schulze will speak to the group on the subject "Management and scope of statistical quality control."

The subject of the Apr. 18 meeting will be "Establishing visual inspection procedures" and will be presented by Charles A. Reed, supervisor of quality control of the General Electric Co., Clock and Timer Department.

RICHMOND, IND. The program for the March meeting will be a conducted tour through the Richmond plant of the Belden Mfg. Co. The tour is scheduled for the evening of Mar. 20.

ROCHESTER The technical sub-group will hold the last meeting of the season on Apr. 2. The speaker will be Dr. Harold F. Dorn, chief, Office of Biometry, National Institute of Health, U. S. Public Health Service. Dr. Dorn will talk to us about "Observations and controlled experimentation."

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The Apr. 16 meeting will have a special attraction for most of us. Our guest speaker will be our good friend Alfred L. Davis, director of public relations, Rochester Institute of Technology and a past president of the Society. Mr. Davis will discuss "Looking ahead with quality control."

ST. LOUIS Roy A. Wylie, quality control engineer, Micro Switch Co., Freeport, Ill., will speak to the section on "Analysis of Variance" on Mar. 22.

SAN BERNARDINO The April meeting will be held at the "Sage Hen" in Upland on Apr. 11. The speaker of the evening will be Ray Miller, North American Aviation Corp., Downey, whose topic is "Vendor qualification."

SAN DIEGO The Apr. 8 meeting will be highlighted by a discussion on sports and officers will be elected for the coming year. This meeting will be a dinner meeting held at the North Park Club House to begin at 6 pm.

SEATTLE The Apr. 9 meeting will be held at the Kaiser Aluminum Company in Tacoma, and will consist of a tour of the plant.

SOUTH BEND -MISHAWAKA Dr. W. R. Pabst, chief statistician for the Bureau of Ordnance, Department of the Navy, will speak to the section on "Q.C. for the Navy." The meeting will be held at 7:30 pm on Apr. 18 at the K. C. Lodge in South Bend.

SOUTH TEXAS H. J. Jacobson, P. R. Mallory Co., will be the speaker at the April Meeting. His topic will be "Quality control by infiltration." This will be a dinner meeting with time and place to be announced later.

TOLEDO Fred D. Reardon, Electric Auto Lite, Spark Plug Div., will speak at the March meeting of the section. The title of his talk will be "Quality control in the manufacture of spark plugs."

TORONTO On Apr. 10, Miss Bonnie B. Small, Western Electric Co., Allentown, Pa., will visit the section. She will discuss "Control chart and analysis for engineering experiments."

UNIVERSITY OF WESTERN ONTARIO A supper meeting will be held at the New Commercial Hotel in Woodstock on Mar. 20. Ben H. Lloyd of Leetham, Simpson & Elliott, Ltd., Montreal, will be guest speaker. Mr. Lloyd's subject for the evening will be "An industrial consultant uses quality control."

On Apr. 17 Clarence R. Burdick, executive director of the Society, will speak on "Practical quality control." The meeting will be a supper meeting to be held at the "Glen Allen" Restaurant on Highway 2, south of London.

WESTERN MASSACHUSETTS A 6:30 pm dinner at the Sheraton-Kimball Hotel, Springfield, will be followed by an 8 pm talk on establishing standards and developing specifications to be given by Oliver P. Beckwith, director of quality control, William Carter Co. Mr. Beckwith is extremely well qualified in that he has wide experience as a quality control administrator, has headed research and engineering groups, and has served as consultant with ASTM committees.

WINDSOR The Apr. 17 meeting will be held in the Ballroom of the Prince Edward Hotel commencing with dinner at 6:30 pm. Individual notices will be mailed at a later date.

YOUNGSTOWN S. P. Sieple, quality control analyst of the Studebaker-Packard Corp., will be the speaker for the Apr. 4 meeting to be held at the Astoria Cafe, Warren, Ohio. His subject will be "Developing a QC program for automation."

"AS YE SOW . . ."

CHICAGO On Mar. 26, quality control director William Lieberman, Pentron Corp., will review for participants in the basic educational series, the wide range of techniques available for sampling programs.

At a subsequent meeting on Apr. 9, the topic "Vendor certification and classification of defects" will be discussed by Dale Gierke of Soreng Div., Controls Corp. of America.

Both meetings will be in Room 785, Roosevelt University with starting time at 7:30 pm.

MILWAUKEE The education committee is continuing its successful series on intermediate quality control. The analysis of variance will be the topic for the next two sessions, the first of which will be at 5 pm on Apr. 15 at the Stratford Hotel.

WESTERN MASSACHUSETTS On Mar. 26, at the last session of the course "Operation research," we will have an open panel discussion. This, we feel, can be open to all interested even though the previous course sessions were not attended. The meeting will be at Winchester Square Library, Springfield, from 7:30-9:30 p.m.

UNIVERSITY OF CALIFORNIA The summer program in the department of statistics of the University of California, Berkeley, Calif., will consist of two sessions: June 17-July 27 and July 29-Sept. 7.

The program includes two of the usual undergraduate courses in each session, adapted primarily to meet the needs of students transferring from other centers who would like to undertake advanced study at the University of California during the regular academic year. Also a research seminar in statistical problems of health will be conducted in close collaboration with the representatives of the Public Health Service and National Institutes of Health. The discussions will begin with the medico-biological side of the problem and will then be followed by the statistical treatment.

MATHEMATICS IN MANAGEMENT A course designed for those who wish to improve the quality of their managerial decisions by making better use of available data will be offered by Marquette University, May 13-15.

The staff includes Gale McElrath, professor of the department of mechanical engineering of the University of Minnesota; Harmon Bayer, quality control consultant from Detroit, Mich.; Dr. Joseph Talacko, assistant professor of mathematics, Marquette University; and Dr. Marvin E. Mundel, vice director of the management center, Marquette University.

The course is limited to 25 enrollees to permit effective discussion of all aspects of each topic to be covered.

The course fee is $54.00. For reservation or further information write to Dr. Russell L. Moberly, Director, Management Center, Marquette University, College of Business Administration, Milwaukee 3, Wis.

TECHNICAL SOCIETIES COUNCIL OF NEW JERSEY MARCH 28

The annual conference and dinner of the Technical Societies Council of New Jersey will be held on Thursday, Mar. 28, at the Hotel Essex House, Newark, N. J.

A symposium on "Controlled quality—a key to profits" will be presented at the afternoon session with T. B. Coleman, Western Electric Co., Inc., presiding. Speakers who will take part at this session are: F. Bruce May, Johnson & Johnson; L. Grant Hector, Sonotone Corp.; Thomas A. Budne, Rath & Strong, Inc., H. F. Dodge, Bell Telephone Laboratories, Inc.; W. J. Masser, General Electric Co.; and Allen R. Crawford, Esso Research & Engineering Co.

An informal get-together will be held at 5 pm in the Elizabethan Lounge followed by the serving of dinner in the Elizabethan Room at 6:30 pm.

The featured address will be given at the evening session to be conducted at 7:30 pm. "Some problems in processing water" will be the address given by Dr. Kenneth C. D. Hickman, nationally known water consultant. John P. Brady, Edel Laboratories will preside.

Reservations are $5.50 per person and may be obtained by writing to T. B. Coleman, Western Electric Co., Inc., 100 Central Ave., Kearny, N. J.

NEW YORK UNIVERSITY

Applying mathematical techniques to operational methods in the graphic arts industries will be the subject of New York University's seventh annual statistical quality control seminar to be held Apr. 22-26, Donald Macaulay, director of the seminar, has announced.

This year, the University sponsored seminar will institute an advanced session for those who have attended previous seminars or have comparable experience. It will run concurrently with the regular program.

In addition to the separate primary and advanced sessions, the seminar will include a combined full-day session on color control and instrumentation.

A manual of several hundred pages that includes all the lecture material from the seminar will be given to the participants.

Further information on the seminar can be obtained from Aaron Feinsot, Director of the Office of Special Services to Business and Industry, Division of General Education, New York University, 6 Washington Square North, New York 3, N. Y.

DIVISIONS

Chemical Division

The winter meeting of the Division Council was held at the Lamar Hotel in Houston, Texas, on Feb. 15. It is interesting to note that for every council member unable to attend there were three present coming from such distant points as California, Minnesota, and Massachusetts.

Is Your Section "High" or "Low" Man on the Totem Pole?

1. Albany
2. Albuquerque
3. Baltimore
4. Baton Rouge-N. O.
5. Birmingham
6. Boston
7. Buffalo
8. Burlington
9. Buzzards Bay
10. Central Illinois
11. Chattanooga
12. Cincinnati
13. Columbus
14. Corning-Elmira
15. Dallas-Ft. Worth
16. Danville-Sunbury
17. Dayton
18. Denver
19. Erie
20. Evansville-Owensboro
21. Georgia
22. Grand Rapids
23. Greater Muskegon
24. Harrisburg
25. Hartford
26. Huntsville
27. Indianapolis
28. Iowa
29. Japan
30. Kansas City
31. Lansdale
32. Lincoln
33. Los Angeles
34. Louisville
35. Memphis
36. Mexico City
37. Mid-Hudson
38. Milwaukee
39. Minnesota
40. Montreal
41. Muncie
42. New Haven
43. Parkersburg
44. Pittsburgh
45. Pittsfield
46. Philadelphia
47. Racine
48. Rhode Island
49. Richmond, Va.
50. Rockford
51. St. Catharines
52. St. Louis
53. Salt Lake City
54. San Antonio
55. San Bernardino
56. San Diego
57. San Francisco
58. Scranton-Wilkes-Barre
59. South Bend-Mishawaka
60. South Texas
61. Syracuse
62. Toronto
63. Tucson
64. Utica
65. Waco
66. Washington
67. Western Ontario
68. Western Massachusetts
69. Wichita
70. Windsor
71. Winnebago
72. Youngstown

At the left are listed in alphabetical order all of the sections whose membership performance is significantly better or worse than the average. Using each section's membership as reported to the National Headquarters office by Feb. 24, 1957, performance was calculated as a percentage of last year's membership at June 30.

The sections listed at the left are those that fall above or below the 95 percent confidence band. The overall average for the Society this month is 98.4 percent.

Also of interest is the major reason for the changes between this list and last months'. The society average increased from 95.0 percent on Jan. 24; consequently sections with insufficient or no increase in membership during the previous month now appear on the low side.

Performance significantly better than average:	Performance significantly poorer than average:
2, 6, 12, 13, 14, 15, 17, 19, 20, 23, 24, 26, 29, 30, 32, 33, 34, 35, 36, 37, 40, 42, 44, 46, 49, 50, 52, 56, 57, 59, 60, 62, 66, 67, 68, 71.	1, 3, 4, 5, 7, 8, 9, 10, 11, 16, 18, 21, 22, 25, 27, 28, 31, 38, 39, 41, 43, 45, 47, 48, 51, 53, 54, 55, 58, 61, 63, 64, 65, 69, 70, 72.

The winter issue of "C. D. News," a nine-page report of activities of the Division, was mailed to all members.

Plans are being formulated for a Chemical Division dinner to be held during the Eleventh Annual Convention. The annual meeting of the Division will be convened following the dinner.

SIGNIFICANT DIFFERENCES

Two staff appointments were recently announced by John W. Biddle, resident director of the development department at the South Charleston, W. Va. plant of Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp. C. J. Kennett has been appointed to the staff position of quality control statistician and C. B. Lamb, has been appointed to the staff position of quality control co-ordinator. Both Mr. Kennett and Mr. Lamb are members of the new Charleston section.

Chicago section member Ernest Robinson of the Johnson and Johnson Co. addressed participants of a Marquette University Seminar on Jan. 8 on the subject "Sales forecasting through the use of statistics."

Mr. Robinson, for 23 years Director of Quality Control at the Chicago plant of Johnson & Johnson, is now Director of Quality Control for all parent company operations in the Johnson & Johnson plants in New Brunswick, N. J., Chicago, Ill., Dallas, Texas, and Menlo Park, Cal. His office is located in the J&J Research Center in North Brunswick, N. J. In addition to his larger responsibilities for quality control at the company level, he will also serve as liaison officer for the company with its international organization. In this new assignment he reports to Dr. W. H. Lycan, Vice-President and Director of Research for Johnson & Johnson.

Ernie is a Fellow and Founding Member of ASQC, and was for many years Editor of the IQC News Supplement (see IQC, Sept., 1953, p. 3). Readers of IQC and his many friends in ASQC note with pleasure this significant recognition and advancement to broader responsibilities in the quality control activities of his company.

A. L. Alk, chairman of the employment committee of the Cincinnati section, has announced that he has accepted a position with the Deerfield Plastics Co., Inc., South Deerfield, Mass.

Charles H. Joseph, secretary of the Cleveland section and formerly director of operations analysis, American Greetings Corp., has been appointed to the position of director of research for that company.

News from the Los Angeles section included these bits of information.

Reed S. Davis, Purex Corp., Ltd., South Gate, has had a change in both job and job title. Formerly supervisor of QC, he is now quality control manager.

Conrad Florentino, North American Aircraft, Inglewood, has been promoted to the staff of the director of QC.

John F. Hinchen, ElectroData Div., Burroughs Corp., Pasadena, has been promoted from assistant manager to manager of the quality assurance department.

A welcome is sent out to Warren Lassen, formerly with Ford Aircraft Engine Div., Chicago, who has moved to Azusa, to become a quality control engineer with Aerojet-General Corp.

The section was pleased to accept the application for membership for Dr. A. M. Mood, president of the General Analysis Corp. Dr. Mood is author of *Introduction to the Theory of Statistics*, McGraw-Hill, 1950.

Howard Todt, North American Aircraft, Downey, has been promoted to chief QC analyst, Autonetics Div. Autonetics is the electro-mechanical engineering and manufacturing division.

Gifford H. Symonds, Metropolitan section member, has been promoted to the position of operations research coordinator in the economic analysis division of Esso Standard Oil Company's manufacturing department.

Mid-Hudson member William Bobalke, Federal Bearing Co., is conducting an advanced course in statistical quality control in the Arlington High School adult education program.

H. Mack Truax, formerly with American Viscose Corp. at Marcus Hook, Pa., has been appointed head of the newly established quality control section as a staff function at the headquarters level of the Atlas Powder Co.'s chemicals division's production department. Mr. Truax is a member of the Philedelphia section.

Rochester section member Fred C. Nilsen, assistant manager of inspection, Taylor Instrument Co., Rochester, has been promoted to manager of inspection. He succeeds Garrett A. Cook, who has moved on to an important engineering assignment in the company.

Walter J. Houlette, a member of the San Bernardino section, addressed a recent meeting of the Valley Industrial Supervisors Club held at the San Bernardino YMCA. His subject was "What quality control can do for the manager."

POSITIONS AVAILABLE

Address all replies to box number references to: American Society for Quality Control, Room 6197 Plankinton Bldg., 161 W. Wisconsin Ave., Milwaukee, Wis.

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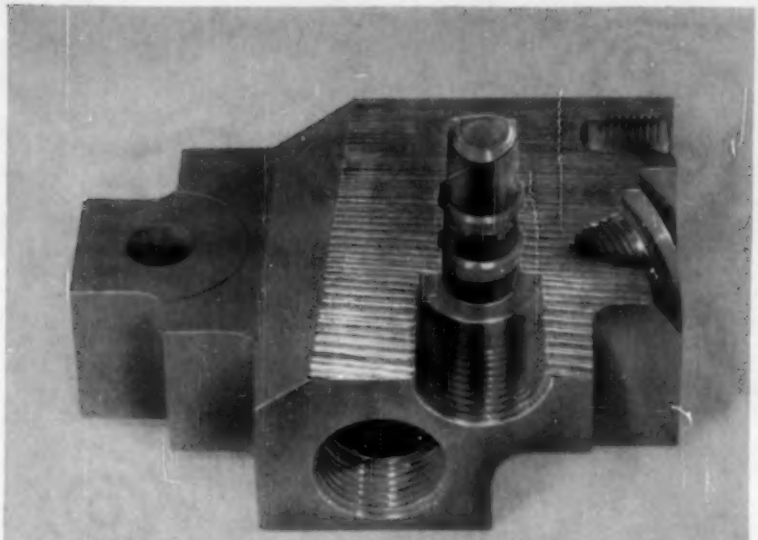
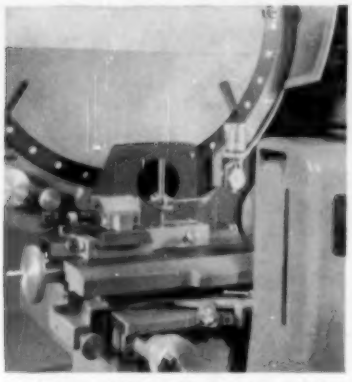
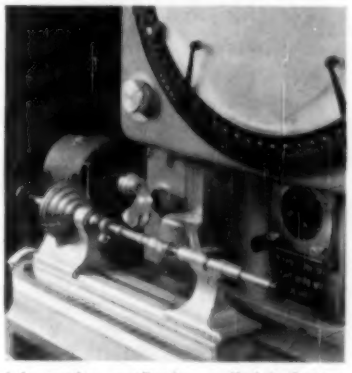


1. Cross section through pressure control valve body shows tricky inspection problem. There are 12 linear and 8 angular dimensions to be measured within the hole shown in cutaway.

2. Part of the receiving inspection department of the aircraft components plant. Model 30 Contour Projector is at the left. Operators work comfortably in normal lighting.



3. Close-up of Model 30 shows tracer fixture and pantagraph. The tracer fixture follows the contours of the hole and translates them into an image on the screen for accurate gaging.



4. In another application, a Kodak Contour Projector, Model 4, is used with a jeweler's lathe, which enables the operator to grind the radii on a servo mechanism piston to a tolerance of .0005" by watching the magnified image during grinding.

2/3 cut in gaging time

helped prove how 23 more Kodak Contour Projectors would return their cost inside 12 months

A leading manufacturer of aircraft components recently purchased 23 Kodak Contour Projectors when cost studies showed the machines *would pay for themselves in 12 months.*

The studies were based on the time and labor saved by Kodak Contour Projectors in inspection of parts like the pressure control valve body pictured above.

This component has 12 linear and 8 angular dimensions to be checked—*all inside a blind hole.* With a Kodak Contour Projector, Model 30, inspection of 25 pieces takes just 3½ hours. Formerly, the same job took 10 hours and was less accurate. Hundreds of manufacturers across the country have had similar experiences with all sorts of complex parts, large and small.

Whether your problem involves receiving, production, or final inspection, there's a Kodak Contour Projector to do the job quickly, accurately, and at low cost. To learn more about how optical gaging can work for you, send for your copy of the free booklet "Projection Gaging with Kodak Contour Projectors," or write for the name of the representative in your area. No obligation, of course.

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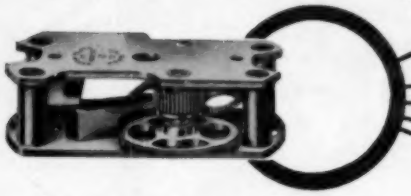

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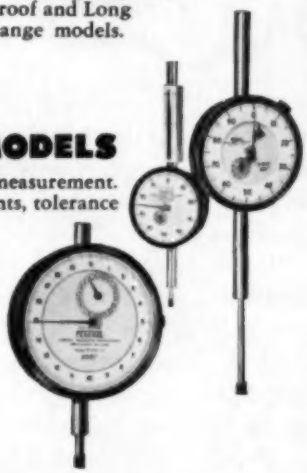

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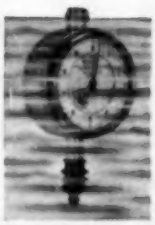

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